STERREKUNDIG INSTITUUT TE UTRECHT

The Astronomical Institute at Utrecht

JAARVERSLAG 1982

Annual Report 1982

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Report over the year 1982

STERREKUNDIG INSTITUUT TE UTRECHT

The Astronomical Institute at Utrecht

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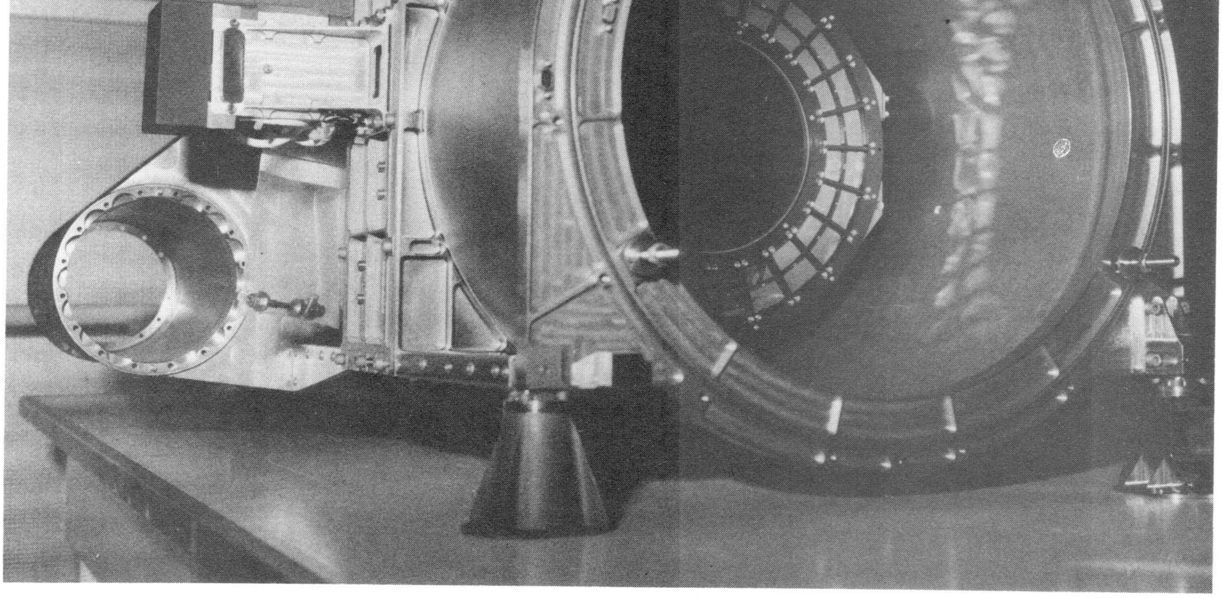


Two X-ray transmission grating systems (500 and 1000 bars mm^{-1}, respectively) have been developed and constructed at the Utrecht Space Research Laboratory, for inclusion in ESA's EXOSAT mission. The grating systems consist of individual grating elements mounted on a ring-shaped holder. They will be used in the converging X-ray path, behind a paraboloidal-hyperboloidal mirror system (Wolter I-type).
The photograph shows one of the grating systems, mounded inside the mirror holder (mirror outer front diameter = 27 cm). At ground command the grating systems can be moved outside the ray paths.

JAARVERSLAG 1982 VAN HET

STERREKUNDIG INSTITUUT TE UTRECHT

INHOUD - CONTENTS:

1. INTRODUCTION

The field of research of the Astronomical Institute at Utrecht is directed at the observation and interpretation of the structures and phenomena in the outer layers of the Sun and stars, and in that field: the study of cosmic plasmas, particularly the instability phenomena therein. Below, a few typical highlights or particular pieces of research are described. For a more detailed description of the development of the scientific program of the Institute reference is made to Chapter 3 of this Report.

X-ray emission in the absence of flares

Schadee, De Jager and Svestka have discovered from the HXIS data that even in the absence of flares there are very often volumes of hot plasma in the active regions corona with temperatures in excess of 6 million degrees. The characteristics of this hot plasma and its time variations seem to be different in active regions of different age. These hot plasma regions are sources of very weak, but clearly recognizable, X-ray emission above 3.5 keV. Long-lived X-ray brightenings, 10^4 times weaker than a flare, but lasting up to 10 hours occur predominantly along the filament channel in the active region, apparently low in the corona. Short-lived X-ray sources, ranging from subflare intensities to 10^{-3} times the flare flux, last for 2 to more than 30 minutes and are probably microflares. They seem to be most frequent in growing young active regions and appear often in areas of newly emerging magnetic flux. Figure 2 shows the record of a typical short-lived source lasting for 10 minutes, and records of the enhanced level of X-ray emission from a long-lived source during two subsequent orbits of the SMM satellite.

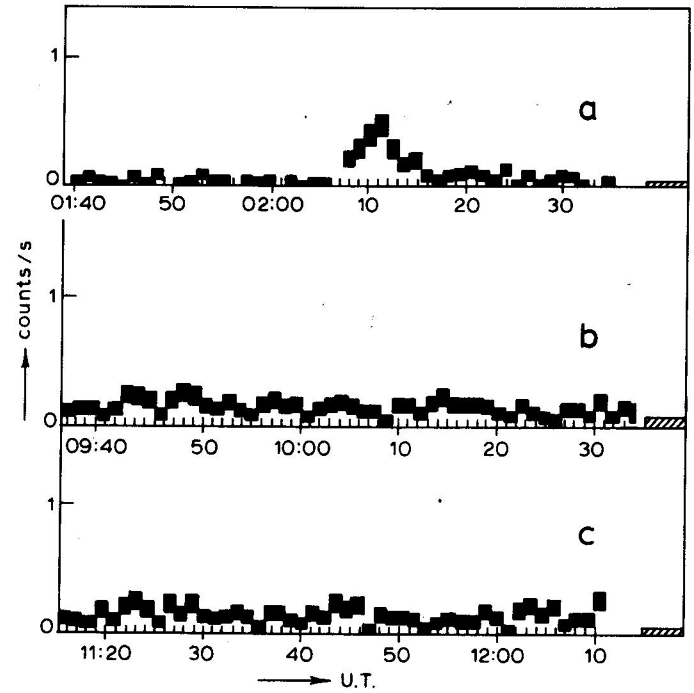


Fig. 2: Time development records (one-minute integrations) of two typical weak X-ray brightenings on May 20, 1980, in a solar active region. (a) A short-lived source (counts per second from 6 pixels of the coarse FOV); (b) A long-lived source (counts per second from 17 pixels of the coarse FOV); (c) The same long-lived source one orbit later. The maximum flux in (a) is ∿ 0.1 counts/second averaged per pixel; the average flux in (b) ∿ 0.1 counts/second per pixel. Energy range 3.5 - 5.5 keV, instrumental background 0.0046 counts/second per pixel. The real background is indicated on the right-hand side of each graph.

'A tradition restored'; the curve of growth

Rutten and Zwaan studied a traditional Utrecht subject: the 'curve of growth'. The curve of growth was introduced fifty years ago by Minnaert, whose earlier interest in biology is reflected by the name he gave to it. The concept is still widely used in stellar spectroscopy to derive element abundances of stars. Rutten and Zwaan scrutinized this old technique for the archetypical case of the solar Fe I spectrum, using predictions of modern NLTE line formation theory and new atomic data of which Rutten, in his cooperation with workers at Kiev (USSR) has demonstrated the validity. Their reappraisal shows that a modified NLTE formulation of the curve of growth is possible and useful; their result for 991 lines is shown in Figure 3.

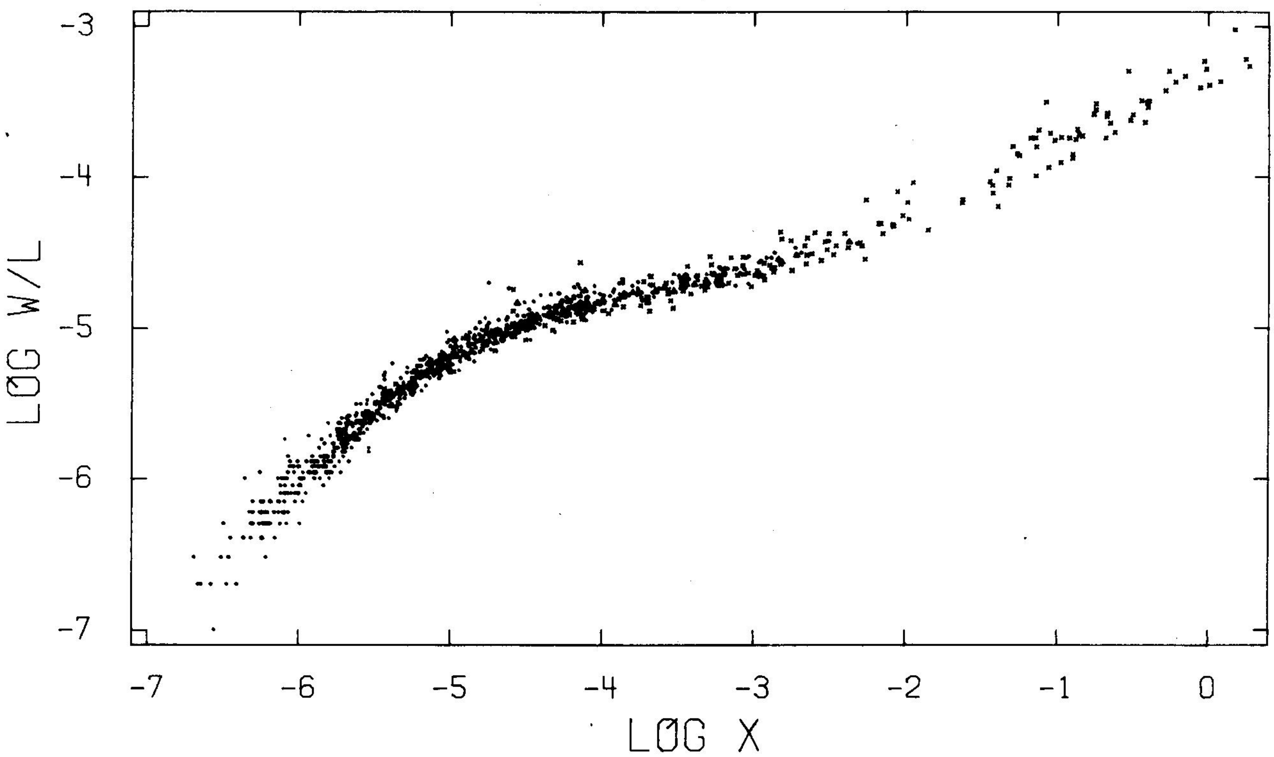


Fig. 3: Curve of growth for 991 solar Fe I lines based on modern NLTE line formation theory. It shows the observed line strength (vertical) against a NLTE population parameter X (horizontal) which is related to the number of absorbing iron atoms.

Fundaments for a new dynamo theory

The strong magnetic fields and the time-dependent magnetic activity observed in the Sun and in many stars must be due to a dynamo mechanism operating in the convection mantles. Current dynamo theories cannot explain, however, that the new observational data indicate that the fields in the convection zone must be quite strong ($B \gtrsim 10^4$ gauss) and nevertheless remain seated deep in the Sun for long times. In his thesis, Van Ballegooijen has demonstrated that such strong fluxtubes are stable in the convective mantle if the angular velocity increases radially outward. Van Ballegooijen has indicated how this stabilization of fluxtubes by differential rotation near the bottom of the convective mantle can be incorporated in a dynamo mechanism which explains the features of the solar magnetic activity cycle.

The observation of eclipsing binaries

In the course of the last few years a new stellar photometer became operative, enabling one to obtain photometric data in the stellar continuous spectra over a broad wavelength range (4000-9000 Å). In this 'Utrecht Photometric System' photometric light

curves are now available of a growing number of eclipsing binaries. Among these is the system U CrB, of which previous observations of the variations in the period had suggested that it was a triple system. The new photometric (Figure 4) data were analyzed on the basis of a new method deduced from Kopal's method of Fourier series expansion. They strengthen the evidence for a third body in the system (cf. also Figure 10 in Chapter 3.1).

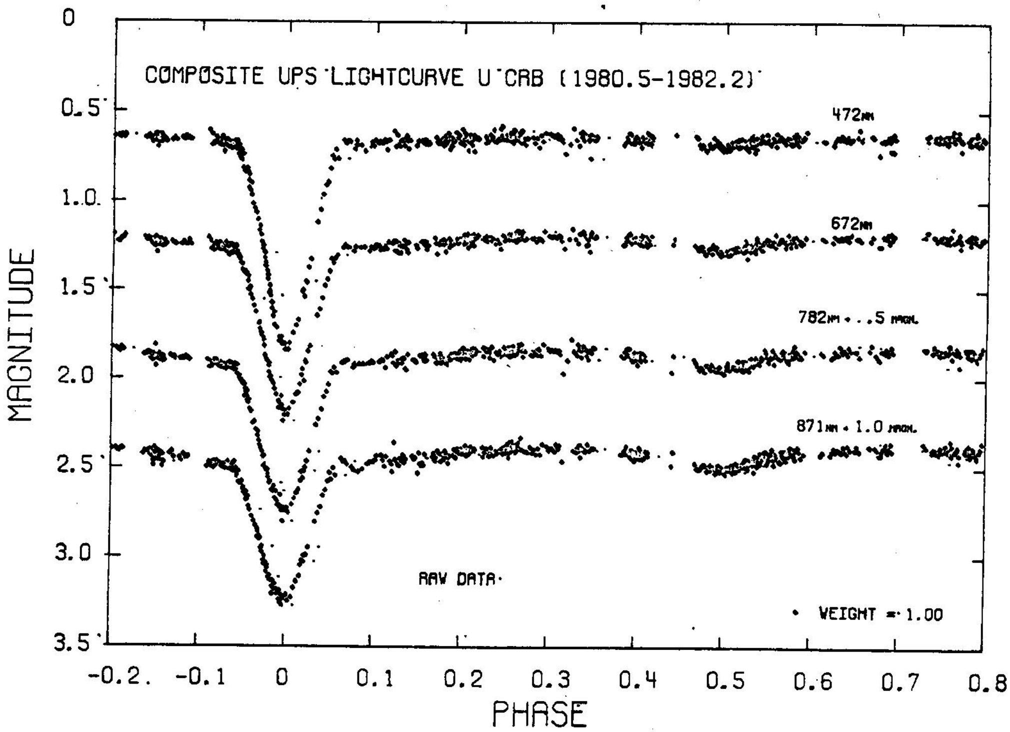


Fig. 4: Light curve of the Algol system U CrB, as obtained through the UPS passbands, relative to the comparison star HD 136654 (with supplemental data from the comparison star HD 137147).

Technological developments and results

The launching of the Balloon-borne Ultraviolet Stellar Spectrometer (BUSS) from the Palestine (Texas) range on October 4, 1982 was an important event. The spectrometer was designed to yield spectra of bright stars with a spectroscopic resolution of 0.03 Å in the spectral range 2000-3000 Å.

October 4, 1982 was a remarkable day anyway, because that day a memorandum of understanding was signed between the Intercosmos Agency and the Netherlands Committee for Geophysics and Space Research. It was agreed that the Netherlands would provide a cosmic X-ray detector (project COMIS) to be placed aboard a Salyut spacecraft.

Since August 1978 the Institute, in close cooperation with scientists from ESTeC (Noordwijk), and from the Imperial College (London) has collected an impressive amount of new data on energy spectra and directional distributions of interplanetary protons with energies between 30 and 2000 keV. These were obtained from the spacecraft ISEE-3, placed in the first Lagrangian point of the Sun-Earth system, at 1.5 million km from the Earth in the sunward direction. We are now looking forward to the consequence of what has been called 'the most complex set of orbital maneuvers NASA has ever undertaken with an unmanned spacecraft'. ISEE-3 is being moved, via a complicated maneuver, to the magnetospheric tail, where a yet unexplored medium will be met. It is foreseen that it will later (1985) move through the tail and within 3000 km of the nucleus of the comet Giacobini-Zinner.

Within the European Space Agency (ESA) the Utrecht Space Research Laboratory has acquired the responsibility for the development of an important part of the instrumentation for the Hipparcos project. The Utrecht contribution consists of the Detector Subsystem, being the instrumental sensors and the corresponding electronics. In 1982 phase B1 (the 'definition phase') of the project was accomplished. During this phase a program of measurements was performed on an Image Dissector Tube of the same kind as the one foreseen for Hipparcos. At the end of 1982, a proposal was realized for the B2-phase of Hipparcos.

The preparation of new space mission proposals is an ever-increasing part of the scientific activities. Personnel of the Space Research Laboratory participated in the SOHO study (Solar High energy Observatory), a mission that was thereupon selected by ESA (with four other proposals) for an assessment study.

On June 22 and 23 a large meeting was held in Bunnik, near Utrecht, organized by ESA and the Utrecht Space Research Laboratory, for a detailed discussion of the merits of the DISCO proposal, being one of the proposals then under consideration by ESA for next flight opportunities. The Workshop was attended by about 120 participants.

2. HET INSTITUUT; ORGANISATIE EN BEHEER

HET STERREKUNDIG INSTITUUT

De Sterrewacht van de Rijksuniversiteit te Utrecht en het Laboratorium voor Ruimteonderzoek vormen samen het Sterrekundig Instituut te Utrecht. De Instituutsraad behartigt de noodzakelijke coördinatie tussen de beide onderdelen van het Instituut.

Samenstelling Instituutsraad

A.C. Brinkman, C. de Jager (vz.), M. Kuperus, J. Heise, C. Zwaan.

2.1. De Vakgroep Sterrekunde en de Sterrewacht

De Vakgroep Sterrekunde is gehuisvest in de Sterrewacht te Utrecht en maakt deel uit van de Subfaculteit Natuur- en Sterrekunde. De Vakgroep omvatte in 1982 80 leden, waarvan 29 kandidaten met hoofdvak sterrekunde. Het Vakgroepsbestuur werd gevormd door het wetenschappelijk personeel (18 in vaste, 5 in tijdelijke dienst), en 12 gekozen leden, 7 uit het niet-wetenschappelijke personeel en 5 studenten, te zamen 35 personen. De Vakgroep was in de Subfaculteitsraad vertegenwoordigd door de leden A. Schadee (lid Subfaculteitsbestuur), T. de Groot en J.H.G. Rosenbaum. Verder hebben de volgende personeelsleden zitting in commissies van de Subfaculteit:
- personeelscommissie: T. de Groot
- financiële commissie: T. de Groot
- commissie voor wetenschapsbeoefening: A.G. Hearn
- onderwijscommissie: zie hieronder bij Onderwijscommissie Vakgroep Sterrekunde
- reglementencommissie: A. Schadee
- vaste examencommissie: H. Hubenet
- startcommissie: H. Hubenet
- onderwijstakencommissie: J. van Nieuwkoop
- begeleidingscommissie basis natuurkunde: H. Hubenet
- commissie herprogrammering natuurkunde: H. Hubenet
- contactcommissie onderzoek van de grondslagen der natuurkunde: A.D. Fokker
- commissie doctoraal toegepaste natuurkunde: J. van Nieuwkoop
- rekentuigcommissie: H. Nieuwenhuijzen
- kiescommissie: G. Geijtenbeek
- structuurcommissie grondslagen der natuurkunde: A.D. Fokker
- bestuurscommissie onderwijs fysische informatica: J. van Nieuwkoop.

Samenstelling van raden en commissies van de Vakgroep per 31-12-1982

Dagelijks Bestuur: T. de Groot (secr.), M. Kuperus (vz.).

Onderzoekscommissie:
T. de Groot (secr.), A.G. Hearn, C. de Jager, M. Kuperus, J.M.E. Kuijpers, C. Zwaan (vz.).

Onderwijscommissie: (tevens deelcommissie van de onderwijscommissie van de Subfaculteitsraad)
J.J. Claas, A.D. Fokker, W. de Graaff (vz.), H. Hubenet (secr.), M. Kuperus, P. Mulder, J. van Nieuwkoop, J. Schrijver, C. Zwaan.

Overlegcommissie deelkredietgebruikers:
H.J. van Amerongen, A. van Drie, T. de Groot, R.H. Hammerschlag, J.R.W. Heintze, E. Landré, H. Nieuwenhuijzen, J. van Nieuwkoop, R.J. Rutten, P.A.H. Smulders, H. van de Stadt.

Werkplaatsplanningcommissie:
A. van Drie, J.R.W. Heintze, T. de Groot (vz.), R.H. Hammerschlag, H. Nieuwenhuijzen, J. van Nieuwkoop, H. van de Stadt, R. van Stappershoef.

2.2. Het Laboratorium voor Ruimteonderzoek

De Werkgroep Ruimteonderzoek van Zon en Sterren (ROZS) is één van de vier werkgroepen van de Commissie voor Geofysica en Ruimteonderzoek (GROC) van de Koninklijke Nederlandse Akademie van Wetenschappen. De GROC stelt het wetenschappelijk programma en de begroting van de werkgroepen vast.

De werkgroep ROZS is gehuisvest in het LABORATORIUM VOOR RUIMTEONDERZOEK te Utrecht. Het beheer van dit laboratorium is ondergebracht bij de Rijksuniversiteit te Utrecht, die ook als werkgever optreedt van het personeel.

Door het Ministerie van O&W werd met ingang van het jaar 1981 een vermindering van het GROC-subsidie toegepast van circa 15%. Om aan inkrimping van het personeelsbestand met 15% te ontkomen werd vanaf dat tijdstip gestart met een poging om deze subsidievermindering te compenseren door betaalde opdrachten te verwerven op het gebied van innovatie t.b.v. het midden- en kleinbedrijf en door contractresearch. Deze poging werd gesteund door het toenmalige Ministerie van WB, dat een overbruggingssubsidie heeft toegezegd aflopende over een periode van enige jaren.

De onderhandelingen van GROC met ZWO en O&W om te komen tot een nieuwe organisatievorm van het ruimteonderzoek als een stichting in ZWO-verband werden voortgezet. Het is zeer wel mogelijk dat de beoogde statuswijziging in 1983 haar beslag krijgt.

Externe Adviescommissie van de Werkgroep:
E.P.J. van den Heuvel, A.M. Hoogenboom (vz.), J. Kistemaker, J.B. le Poole, S.R. Pottasch.

Werkgroepleider:
C. de Jager.

Directeur Organisatie en Wetenschap:
Deze positie was in 1982 vacant. Ad interim werden de verschillende bestanddelen van deze functie ingevuld door A.C. Brinkman, J.P. Imhof en J.J. van Rooijen.

Bestuurscommissie:
A.C. Brinkman, J. Heise, J.P. Imhof, C. de Jager (vz.), J.J. van Rooijen.

Toegevoegd aan de bestuurscommissie zijn:
Veiligheidscommissie: H.B. Buurmans, A. van Dongen, H. Goulooze (vz.), A.G.W. Maas, J.J. van Rooijen, C. Timmerman.

Brandpiket: D.C. van Cooten, J.H. Dijkstra, C.J.Th. Gunsing, A.G. van der Horst, M.C. Lahr, J.G. Leeman, C.G. Monderen, W.A. Muysert, T.H.J. Peters, M.J. Rijnsent, Z.Th.R. Salverda, C. Timmerman , G. Velders, P. Versteeg, J.B. Vogel.

EHBO: J.M. Braun, A. van Dongen, J.G. Leeman, C.G. Monderen.

Wetenschapscommissie:
J. Heise, P. Hoyng, K.A. van der Hucht, C. de Jager (vz.), R. Mewe, G.A. Stevens, Z. Svestka.

Coördinatiecommissie:
H.F. van Beek, A.C. Brinkman, R. Hoekstra, J.P. Imhof, T.M. Kamperman, P. van Kralingen, R. Mewe, J.J. van Rooijen (vz.), J.B. Vogel.

Toegevoegd aan de coördinatiecommissie zijn:
Gebouwencommissie: A. van Dongen, J.J.M. van der Laan, M.J. Rijnsent, Z.Th.R. Salverda, J.B. Vogel (vz.).

Commissie Rekentuig: T.M. Kamperman (vz.), W.A. Mels en A.P. Naber.

Instrumentencommissie: A. van Dongen, J.P. Imhof, J.J.M. van der Laan en J.B. Vogel (vz.).

Personeelsraad:
J. van Geffen, T.M. Kamperman, A.G.W. Maas (vz.), M.J. Rijnsent, E.W.P. Schrijvers, G.A. Stevens.

3. SCIENTIFIC REPORT

3.1. THE OBSERVATORY

Optical Solar Research and related Stellar Research

The research topics, issuing from solar optical data, concern spectroscopic diagnostics, hydrodynamical and magnetohydrodynamical phenomena in the Sun, and similar topics for late-type stars. Projects: 1. Formation of spectral lines, 2. Velocity fields, 3. Magnetic fields and magnetic activity, 4. Development of solar instruments.

Staff: R.H. Hammerschlag, O. Namba, R.J. Rutten, C. Zwaan.
Fellowships: A.A. van Ballegooijen, J.J. Brants (RUU), F. Middelkoop (until June 1982, ASTRON), B.J. Oranje (ASTRON), C.J. Schrijver (GROC-RUU).
Collaborator: R. Mewe (LRO).

Collaboration with staff members of:
-- Sacramento Peak Observatory, New Mexico, USA
-- Kitt Peak National Observatory, Arizona, USA
-- Mt. Wilson Observatory, California, USA
-- Herzberg Institute of Astrophysics, Ottawa, Canada
-- Observatory Ukrainian Academy of Sciences, Kiev, USSR
-- Harvard Smithsonian Center for Astrophysics, Cambridge, USA
-- Observatory at Leiden
-- Astronomical Institute, University of Amsterdam

Rutten completed his analysis together with R.I. Kostik (Kiev, USSR) of the formation of the weaker Fe I lines in the optical solar spectrum. The results were subsequently used in a critical reappraisal, together with Zwaan, of the 'curve of growth', introduced at Utrecht fifty years ago. They reformulated this method, including predictions from modern NLTE line formation theory, and tested it using solar Fe I lines. The result (Figure 3 of Introduction) is the best curve of growth ever produced, but it can yet be improved because the remaining scatter is mostly due to observational errors. Rutten and Van der Zalm undertook to reduce these using modern observational data.

Namba completed the investigation of line profiles and line shifts of C I 5052 Å in hot granules and cool intergranular lanes, the smallest convective elements in the Sun.

Oranje completed an analysis of the Ca II K line-core profile of the Sun-as-a-Star in ∿ 200 spectra recorded with the Utrecht solar telescope and spectrograph at varying levels of solar activity. He found that all line profiles can be well described by the sum of the solar-minimum profile plus a 'plage emission profile', scaled to the level of magnetic activity (Figure 5). From the profile of the quiet Sun and this plage emission profile, Oranje synthesized 'stellar' Ca II K line profiles for solar-type stars of different activity levels (Figure 6). Comparison with observational data shows that, while the Sun at maximum activity is covered for 5% with Ca II emitting plages, the most active stars are covered by plages for as much as 65%.

Oranje continued his analysis of UV spectra of late-type stars obtained with the International Ultraviolet Explorer. The remarkably tight relation $F_{TR} (:) F_{chrom}^{1.44}$ is now extended (Figure 7) with pre-main-sequence stars, contact binaries and extremely rapidly rotating giants. At low emission a minimum F_{chrom} is found, representing a ubiquitous chromospheric emission not associated with transition-region emission or coronal emission. Such stars have a 'coronal hole' over their entire surface, or are without any magnetic structure.

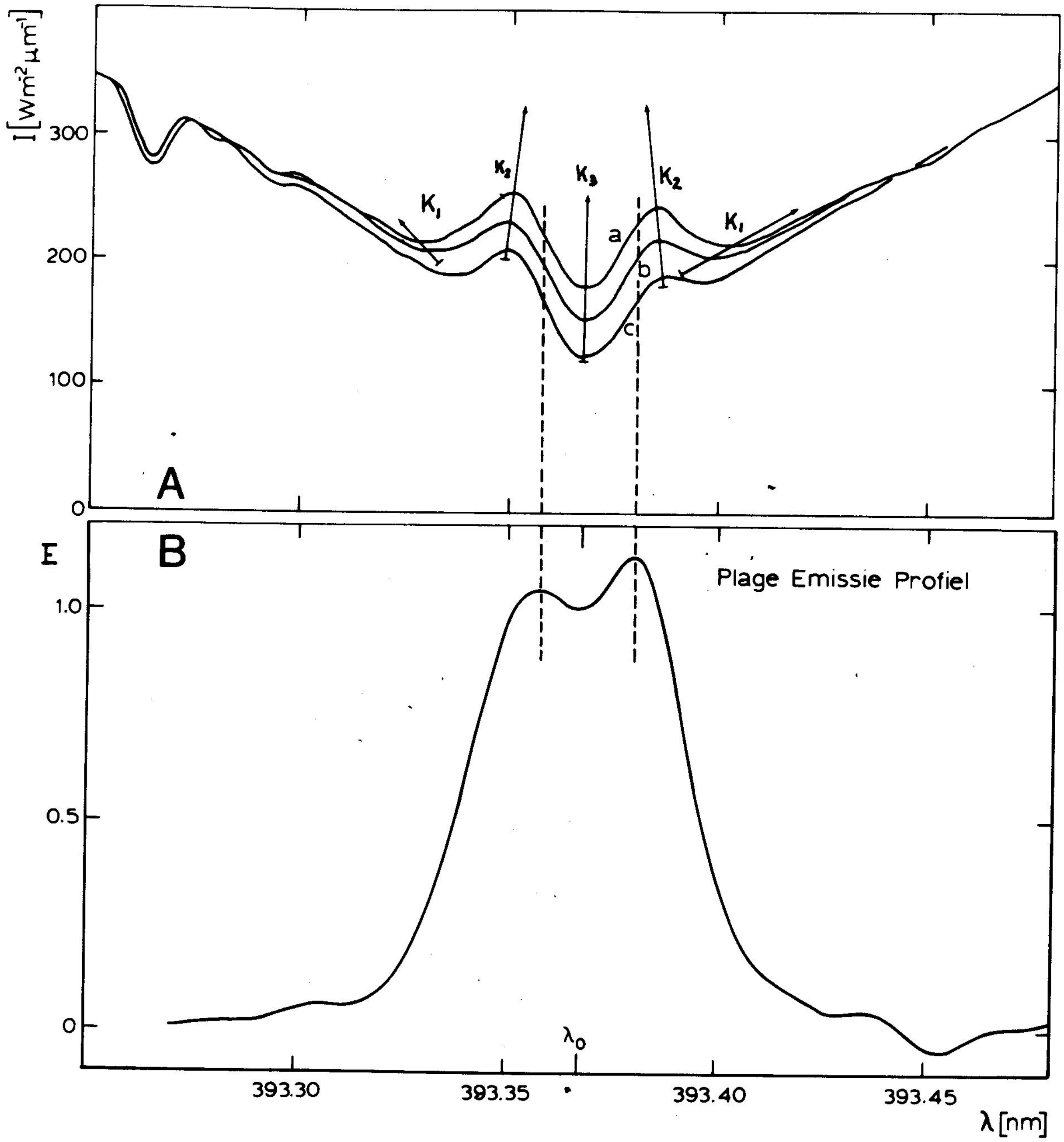


Fig. 5: *Top : Solar Ca II K irradiance profiles. Arrows indicate changes for varying activity.*
Bottom: Plage emission profile.

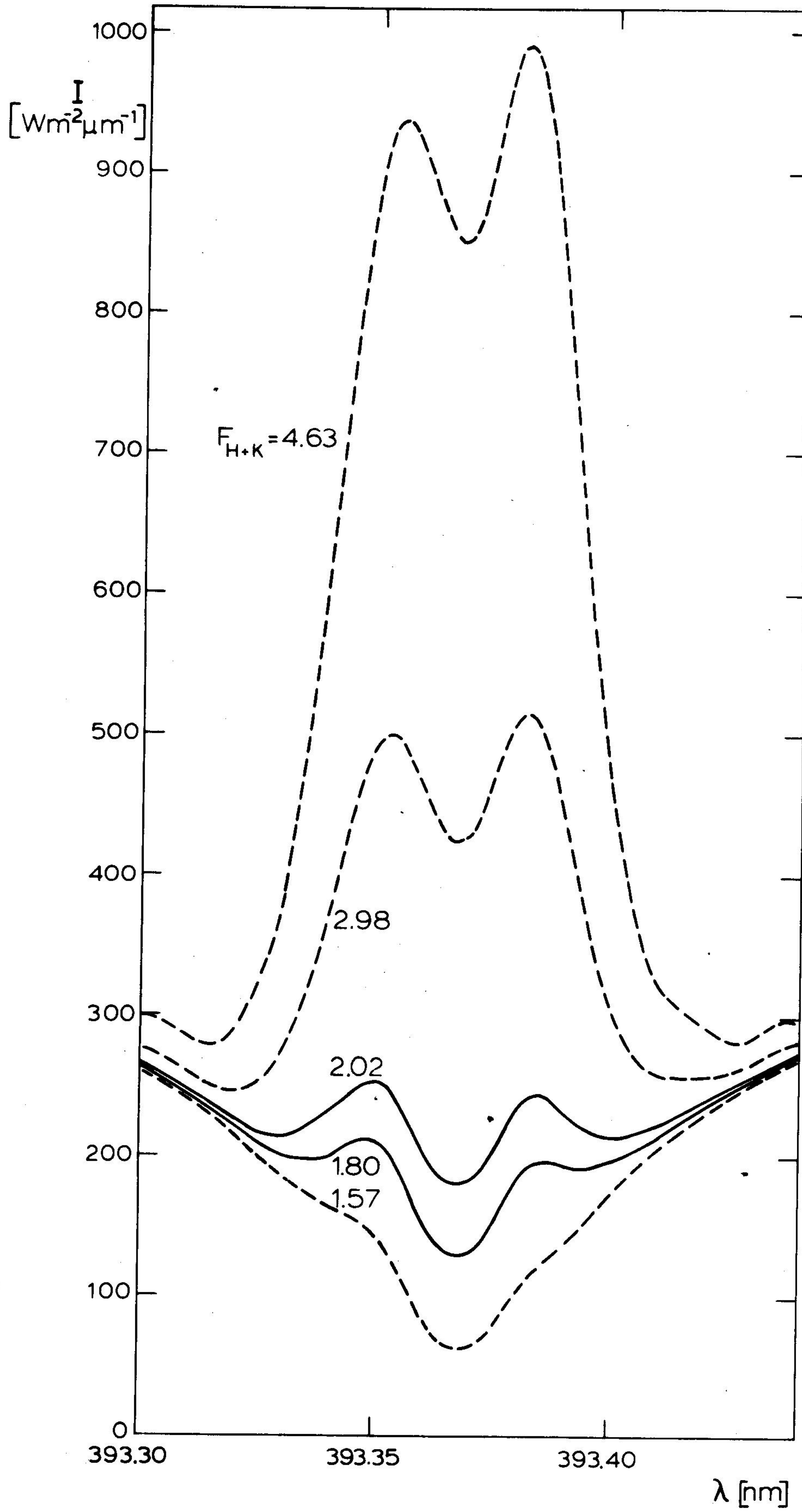


Fig. 6: *Measured solar Ca II K profiles (solid) and predicted stellar Ca II K profiles (dashed), for varying activity levels.*

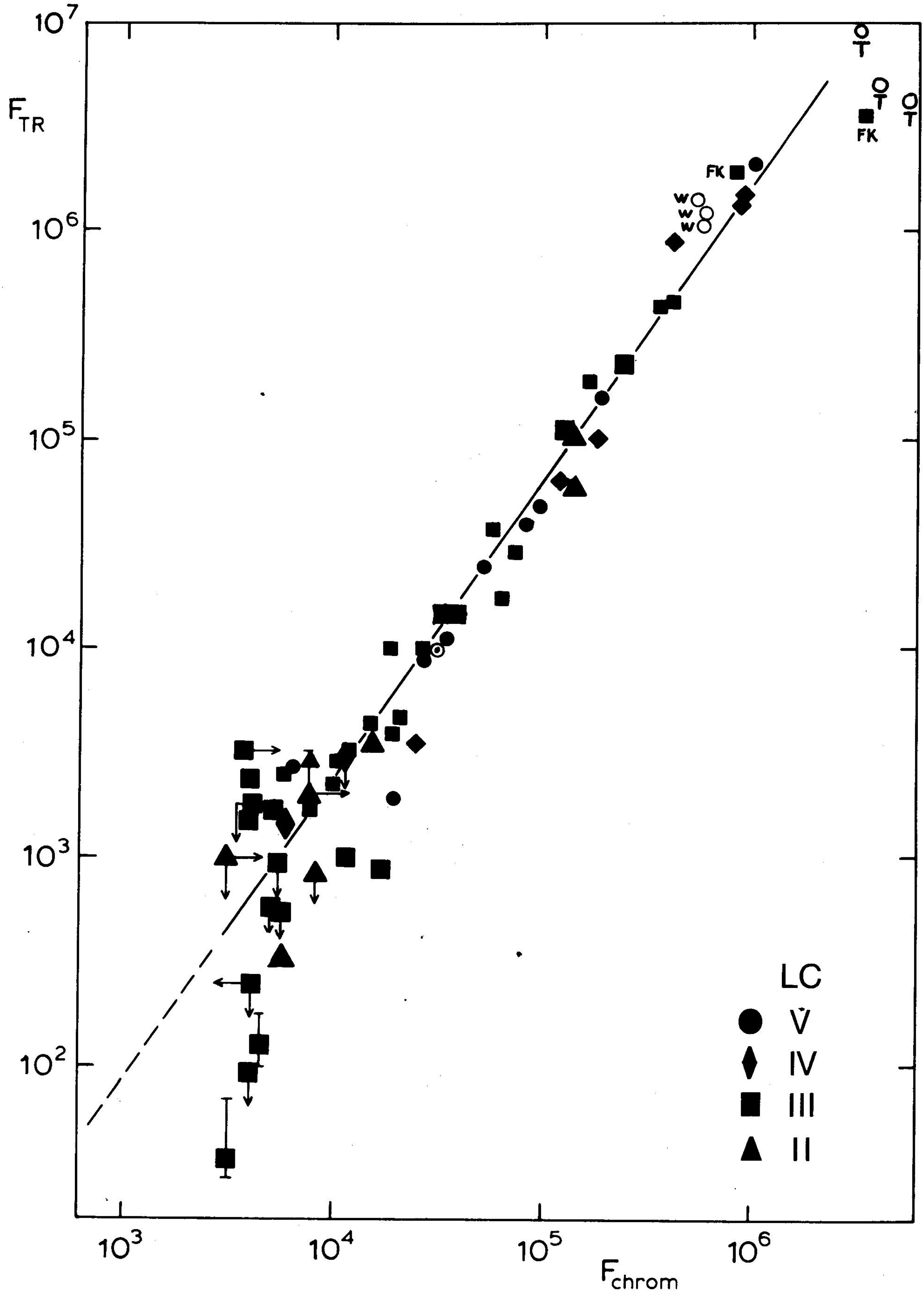


Fig. 7: Transition-region flux against chromospheric flux in the UV for various stars.

From their analysis of soft X-ray emission from late-type stars Schrijver, Mewe and Zwaan found a similar relation $F_x \propto \Delta F_{H+K}^{1.67}$, where F_x is the X-ray flux and ΔF_{H+K} is the chromospheric emission flux measured in the Ca II H and K line cores. These relations between the chromospheric-, transition-region and coronal fluxes indicate a strong coupling between the different parts of the outer stellar atmosphere, probably due to the magnetic field.

Middelkoop completed his thesis on the Ca II H and K emission from late-type stars. He found that the chromospheric emission increases with increasing stellar rotation rate, and that the other manifestations of magnetic activity, for instance the fluxes from the transition region and the corona, increase steeply with increasing rotation rate.

The strong magnetic fields and the time-dependent magnetic activity observed for the Sun and for many stars are due to a dynamo mechanism in the convective mantles of the stars. In his thesis Van Ballegooijen has laid the foundation for a new dynamo theory.

An important clue on the magnetic structure in the convective mantle may be obtained from observations of the emergence of a new active region into the solar atmosphere. Brants analyzed spectra and photographs of such an emergence which Cram, Zwaan and Brants had collected at Sacramento Peak Observatory during excellent observing conditions. One result is that the newly emerging magnetic fluxtubes are surprisingly strong ($B \gtrsim 1000$ gauss) and quite slender.

Hammerschlag and the workshop at the Observatory and at the Physical Laboratory continued the construction of an open solar telescope, which is a prototype for solar and stellar telescopes according to new concepts.

Extended atmospheres of stars

Research into mass loss from stars and the associated corona, including observations in the ultraviolet and X-rays and including theoretical work.

Staff: A.G. Hearn, K.A. van der Hucht (SRL), C. de Jager (SRL), H.J.G.L.M. Lamers (SRL), N.P.M. Kuin (ZWO), P.C.H. Martens (ZWO).

The report of the work done by colleagues in the Space Research Laboratory, that is by De Jager, Van der Hucht en Lamers is given in section 3.2.

Martens and Kuin have extended their work on the thermal stability of coronal loops to include the mechanism of resonant electrodynamic heating proposed by Ionson. They find that just as in the case of the models of coronal loops with a constant mechanical heating the static thermal equilibrium of the loop is unstable and that the time dependent solutions for the plasma in the loop are cyclic. This solution consists of a short, cool phase and a long hot phase. The long hot phase is almost identical with the static solution and this explains the static appearance of a loop.
In addition to this cyclic behaviour catastrophic transitions in the X-ray emission of a loop may occur as a result of a gradual change in the loop length or the magnetic field strength. Similar catastrophes had already been demonstrated for the static solutions by Martens and Kuperus. The transitions take place in about 30 minutes, which is much shorter than the period of the thermal oscillations, and is about equal to the radiative time scales of these loops as was estimated by Martens and Kuperus. The strong changes in X-ray emission that were seen in the Skylab observations are identified with these catastrophes.

Hearn has completed the extension of the coronal model calculations of Hearn and Vardavas to coronal models heated by a mechanism with a very long dissipation scale length.

One of the applications of coronal models heated in this way is to try and explain the high velocity of the solar wind observed in the high speed streams coming from coronal holes. The measured velocity is 3 or 4 times greater than can be explained from a solar wind from a simple coronal model heated at the base of the corona. Earlier work by various authors had given conflicting results. Some authors concluded that adding extra heating in the outer layers of the corona will increase the final velocity of the wind while other authors concluded it would reduce it. This discrepancy has been resolved by the present calculations. They have shown that increasing the coronal heating, while keeping its distribution constant, will increase the final velocity of the wind if the wind represents only a small part of the total energy balance of the corona. Whereas extra heating will decrease the final velocity of the wind if the wind represents a substantial part of the energy balance of the corona. This difference is responsible for the confusion. The present calculations show further that keeping the total heating of the corona constant, but changing its distribution so that more of the heating takes place at greater distances, will always increase the final velocity of the wind. In some cases the wind absorbs a dominant part of the mechanical heating of the corona and this can become a very efficient convector of heating to mass loss.

It appears that the high velocities and large mass loss rates coming from coronal holes can be explained by a corona heated by a mechanism with a long dissipation scale length. This does not rule out however the suggestion that they can also be explained by Alfvén wave pressure.

Evolutionary Stages of Selected Eclipsing Binaries

This research concentrates on the study of evolutionary stages of selected eclipsing binaries by spectroscopic and photometric means and adequate interpretation programs.

Staff: R.H. van Gent, J.R.W. Heintze, C. de Jager, A.C. de Landtsheer.
Technical coworkers: H.J. van Amerongen, G. van Gelder, P. Hoogendoorn, J.H.G. Rosenbaum, R. van Stappershoef, G. van Voorst.

Cooperation with:
-- the Astronomical Institute Pannekoek of the University of Amsterdam
-- the Astronomical Institute of the Free University at Amsterdam
-- the Astronomical Institute of the Catholic University at Nijmegen
-- the Astronomical Institute of the Free University of Brussels, Belgium
-- the International Foundation of the high altitude research station Jungfraujoch and Gornergrat (office: Bern, Switzerland).

The Dutch Observatory in Switzerland

This is a joint project of the first three of the Institutes mentioned, and the Utrecht Astronomical Institute. During 1982 10 Utrecht observers (among them 8 students) each visited the station for about a month. Two Nijmegen students participated on the Utrecht program. Six Amsterdam students carried out their own programs.

The sliding roof has been supplied with an electric motor, an electronic workroom was installed and some safety provisions were realized.

Instrumental Development

The stellar photometer (continuously operational since 1979 February at the Dutch Observatory in Switzerland) was brought to Utrecht for revision and some improvements. Among other things: the photometer and its electronics were connected with an Apple computer complete with monitor, printer and 2 discdrives (one for on-line reduction). The student Langerwerf has done all the tests in the laboratory and has carried out the first measurements with the revised instrument.

The students Molenaar and Mulder have recalibrated very accurately all colour- and grey filters. One interference filter had to be replaced. A new Hα profile (rectangular transmission profile) has been ordered. The optimal characteristics of this filter were calculated by Molenaar.

The student Van der Veen developed a program with which the long periodic component of the scintillation can be determined from the raw data; this scintillation can thus be better accounted for in the reduction of the raw data.

Due to an overload of work of the mechanical- and electronic workshops the construction of the μm spectrograph was postponed to 1983.

Observations

lightcurves in the Utrecht Photometric System (UPS)

First priority objects for the photometric observations in the UPS at the Dutch Observatory in Switzerland were the following eclipsing binaries: the relatively wide system: YZ Cas (B9.5 IVm + F1 V); the Algol's: TV Cas (B9V + G7 IV), U CrB (B5 + G2 III-IV), λ Tau (B3V + A4 IV), u Her (B1.5 Vp + B5 III) and the RS CVn star: σ^2 CrB (G0 V + G1). UPS lightcurves of TV Cas obtained in 1979/1980 were shown in the 1980 Observatory Report. Figure 8 of the present report shows normal points of the primary- and secondary minimum of YZ Cas in 4 UPS colours. The Figures 4 (Introduction) and 9 show raw data of the lightcurves of U CrB and of u Her.

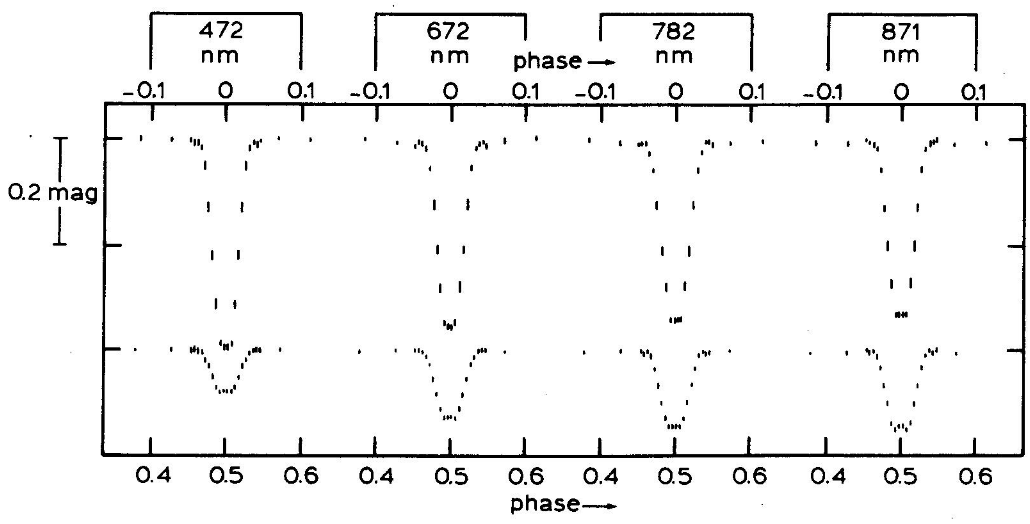


Fig. 8: Normal points of the primary (above) and secondary minimum of YZ Cas in four wavelength bands of the UPS.

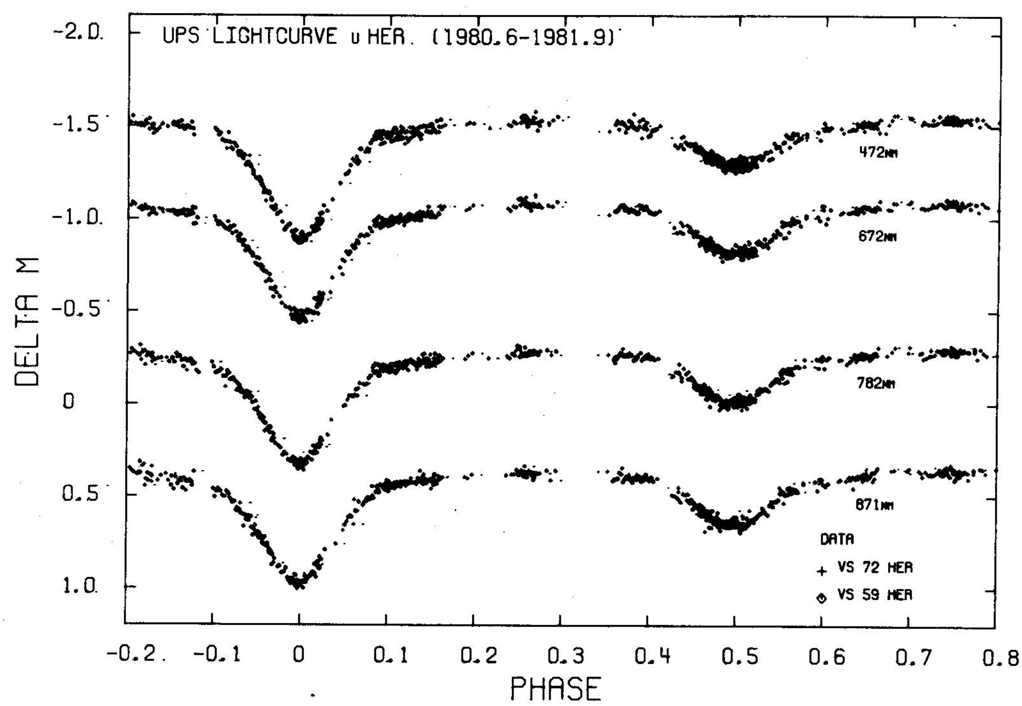


Fig. 9: Raw data on the light curves of u Her in four wavelength bands of the UPS.

IUE

Heintze and De Landtsheer have obtained IUE spectra of YZ Cas, TV Cas, U CrB, λ Tau, u Her and V367 Cyg.

Near Infrared Spectra

In December 1982 Nieuwenhuijzen and Cornelis tried to get spectra of λ Tau in the μm region at phases 0, ¼, ½ and ¾ with the Fourier spectrometer of the University of Liège (Belgium) at the Jungfraujoch station in Switzerland. This observing run failed due to bad weather circumstances.

Radio measurements

With the Westerbork Synthese Radio Telescope Kuijpers observed YZ Cas, TV Cas and σ^2 CrB at a wavelength of 6 cm.

Interpretation

A computer program has been made operational by the student Mulder for calculating spectral-line profiles in the optical - and UV wavelength region. With this program metal abundances are currently being determined from the IUE spectra of the systems in study. At the same time a better determination of the T_{eff} of these systems is now possible.

De Landtsheer found small but significant secular variations of at most 0.02 mag in the UPS lightcurves of TV Cas as obtained in 1981/82 compared with those as obtained in 1980/81. He also found that the momentaneous period of this system during that interval of one year did not change within the 5th decimal, whereas this period was slowly decreasing certainly since 1950. He found the following parameters for YZ Cas and TV Cas.

	$M_{hot}/M_\odot$	$M_{cool}/M_\odot$	$R_{hot}/R_\odot$	$R_{cool}/R_\odot$	$T_{eff_{hot}}$ (K)	$T_{eff_{cool}}$ (K)
YZ Cas	2.32 $\pm$ 0.01	1.35 $\pm$ 0.01	2.6 $\pm$ 0.01	1.37 $\pm$ 0.01	10300 $\pm$ 55	7200*
TV Cas	2.8 $\pm$ 0.3	1.3 $\pm$ 0.1	2.2 $\pm$ 0.2	2.5 $\pm$ 0.2	11000*	5250 $\pm$ 70

*assumed on the basis of the (mass, radius) relations of Habets and Heintze: 1981, Astron. Astrophys. Suppl. Ser. *46*, 193.

With the IUE spectra the photospheric metalabundances are being determined and the T_{eff} checked. In cooperation with J.P. de Greve of the Free University at Brussels (Belgium) the evolutionary stages of these systems are being determined.

Van Gent reduced the UPS photometric data of U CrB to the lightcurves shown in Figure 4 (Introduction) by means of the Steenbeek-method (Observatory Report 1981). The interpretation program according to Kopal (Fourier transform technique) is being made operational by him at the Utrecht Astronomical Institute as a supplementary program to those of Wood and of Wilson and Devinney already in use at the Institute. Some new epochs of primary minimum were determined by him with Kopal's method. The new O-C values slightly change the light-time curve (see Figure 10) giving rise to a small change of the orbit of the possible third component. All changes are within the error limits.

The student Van der Veen reduced the UPS photometric data of u Her, the most massive Algol system. He applied his method as described in the section 'instrumental development'. The lightcurves (raw data) are shown in Figure 9. The red curves show a flat part in the secondary minimum. The UPS measurements indicate convincingly that the period is decreasing.

The student Maas reduced the UPS photometric data of σ^2 CrB so far obtained with the Steenbeek- and the Van der Veen method as well. The normal points show deviations from a straight line of at most 0.03 mag in the phase interval -0.2 to +0.3. This work is carried out in cooperation with A.C. Brinkman of the Space Research Laboratory. IUE and EXOSAT time is granted.

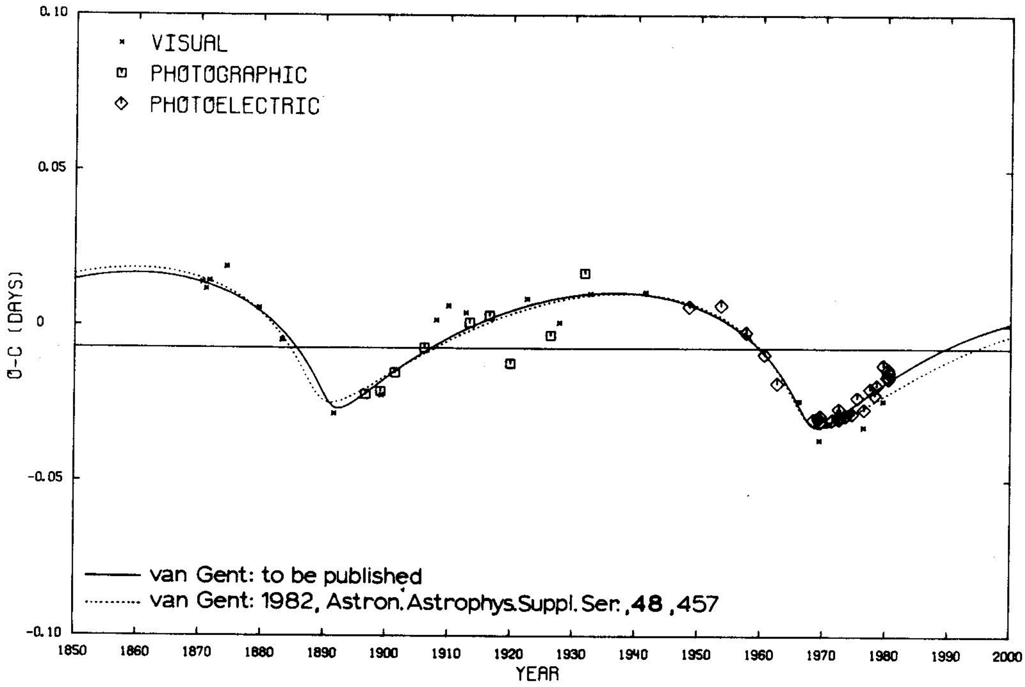


Fig. 10: Observed minus computed epochs of minimum of the system U CrB, compared with calculated values (curves) based on the assumed existence of a third component.

Radio-astronomical research at the Utrecht Observatory

The investigation of non-thermal radio-emission of the Sun, the interpretation of rapidly fluctuating radio-phenomena.

Staff: A.D. Fokker, J. Kaastra (ZWO), J.M.E. Kuijpers, J. van Nieuwkoop.

Radioheliographic observations obtained with the Westerbork Synthesis Radio Telescope in 1981 were further analyzed by Allaart and Kaastra. Kaastra studied in particular a solar flare event observed on May 16, 1981. With the addition of optical observations in Hα (from Hungary) and with radiospectrographic and X-ray data secured by Czechoslovak colleagues, a rather complete picture of this phenomenon could be obtained. In particular the flare build-up phase proved to be interesting. Evidence obtained before by Kattenberg that the λ 6 cm radiation originates at the footpoints of magnetic loops was confirmed.
A small flare event that was also observed by means of VLBI (Dwingeloo-Onsala) showed characteristics of the impulsive phase with interesting implications for the theory.

The student Langerwerf participated in the analysis of some more flare events.

Van Nieuwkoop and Allaart developed a method for the analysis of available WSRT heliographic material at λ 50 cm.

Van Nieuwkoop continued his study on the positions of stormbursts using interferometric records at 243 MHz.

Fokker studied the so-called fiber-bursts in the type IV decimeter continuum on records obtained with the 60-channel radiospectrograph and indicated an alternative explanation for the adjacent emission/absorption ridges of this phenomenon.

Kuijpers worked on the theory of particle acceleration in solar flares as well as in centres of activity (together with K. Tapping), with special attention to the effects that are due to the existence of electric double layers.
Furthermore he made use of the WSRT for a first series of observations of flare stars in a campaign that was combined with ultraviolet observations with the IUE. These observations comprised the RS CVn system σ^2 CrB and the Algol-type objects TV Cas and V367 Cyg.

Plasma- and High Energy Astrophysics

The working group of plasma and high energy astrophysics aims at the study of magnetohydrodynamic and collective processes in astrophysical plasmas such as the outer layers of Sun and stars, accretion discs around compact objects and extragalactic plasmas.
Particular emphasis is on the understanding of the energy partitioning over thermal and non-thermal components in magnetically active, explosive sources.

Staff: M. Kuperus, J.M.E. Kuijpers, J. van Nieuwkoop, A. Duijveman (SRL), P. Hoyng (SRL), J. Heise (SRL), J. Kaastra (ASTRON), P. Martens (ASTRON), C. Slottje (ZWO), F. Verbunt (ZWO).

Members of the working group have a close cooperation with the following scientific institutes:
-- Observatoire de Meudon, Meudon, France
-- Institut d'Astrophysique, Paris, France
-- Osservatorio Astrofisico di Arcetri, Firenze, Italy
-- Universitaire Instelling, Antwerpen, Belgium
-- Astronomical Institute, Cambridge, England
-- Ruhr Universität, Bochum, FRG
-- NASA Goddard Space Flight Center, Greenbelt, USA
-- University of Maryland, College Park, USA
-- Herzberg Astronomical Institute, Ottawa, Canada.

Research projects:
1. Energy partitioning in astrophysical plasmas
2. Particle acceleration and radiation processes
3. Magnetic activity in flare stars and accretion discs.

Kuperus investigated the electrodynamic coupling of coronal structures to the photosphere, to find the origin of the coronal heating mechanism. The application of equivalent electric circuits appears to be a fruitful method to describe the energy partitioning in quiet coronal structures as well as in flares.

Van Nieuwkoop and Kuperus started a study of the classification of several plasma instabilities in terms of the varying resonant properties of distinct equivalent circuits.

Tapping, Kuperus and Kuijpers applied the methods of circuit theory to microwave radiobursts. Strong evidence is found for the occurrence of double layers in the solar corona as a dissipative and acceleration mechanism.

Martens and Kuperus applied the theory of resonant electrodynamic heating to coronal structures and demonstrated that sudden transitions (catastrophes) in coronal loops may occur. They showed that such catastrophical behaviour is identical with the observed loop brightenings and evacuation.

Kuperus and Chiuderi started an investigation of the influence of boundary conditions on equilibrium and stability of confined astrophysical plasmas with the goal to obtain observable parameters that determine the energy partitioning in remote sources. This research will be one of the important topics in a CECAM workshop that will be organized in August 1984 in Orsay/Meudon, France entitled 'Energy Partitioning in Astrophysical Plasmas'.

Kuperus, Ionson, Kieboom and Burm continued their research on the formation of accretion disc coronal based on the concept of a magnetically structured corona which is electrodynamically coupled to the disc turbulence. By investigating the hard X-ray Compton radiation and its time variability one has a means of penetrating into the nature of the accretion disc turbulence which has been hitherto obscure. Scaling laws

for Comptonized loops have been derived as well as a turbulent power spectrum, the latter based on new ideas of accretion disc dynamo action.

Kuperus, Westerhof and Stollman studied the magnetic coupling of an accretion disc with a neutron star in order to understand the spin-ups and spin-downs of neutron stars as well as the pulsar emission mechanism (the disc theory). A detailed study is made on possible reconnection processes in accretion discs.

Duijveman completed a study on X-ray imaging and interpretation of impulsive solar flare phenomena. He found, using the hard X-ray imaging spectrometer aboard the SMM satellite, evidence that the impulsive hard X-ray solar flare emission at the foot-points of a flaring loop is caused by the injection of energetic electrons.

Verbunt completed a study of mass transfer in stellar X-ray sources and found that loss of angular momentum by stellar winds is more important than gravitational radiation in close binaries. No consistent accretion disc model exists in those regions of accretion discs where radiation pressure dominates. For the interpretation of the optical emission lines heating of the gas by thermal radiation from the neutron stars is necessary.

Kuijpers had the opportunity to stay for half a year at the Sterrenkundig Instituut in Amsterdam for the study of stellar high-energy phenomena. There he delivered a series of 8 lectures on plasma astrophysics.

Henrichs and Kuijpers considered the possibility of fast braking of magnetospheres of fast rotating neutron stars in the sleeping phase before the onset of X-ray pulsars by instabilities.

Kuijpers and Pringle studied radial accretion flow onto a magnetized white dwarf. They found: 1) The existing conductive shock solution by King and Lasota to be invalid since the shock height is comparable to the relevant electron-ion collisional mean free path; 2) A new bombardment solution exists in which the incoming beam transmits its energy to the dense atmosphere over one mean free path. The density contrast can be much larger than the adiabatic value four and the energy is radiated in soft X-rays ($T \sim 10^7$K); 3) Since cooling takes place in the accretion process the flow will be lumpy. If the density contrast in the lumps is sufficiently large they can penetrate to large optical depth in the atmosphere and the energy will be radiated at UV and soft X-ray wavelengths in agreement with the observations.

Tapping, Kuijpers, Kaastra, Van Nieuwkoop, Graham and Slottje completed a VLBI study of an impulsive solar flare in which they found strong indications of an unresolved component (40 km diameter) during the initial phase.

Kaastra, Kuijpers and Tapping started a study of the energy partitioning of a solar flare for which VLBI - and Westerbork Observations (at λ = 18 cm and, respectively, 6 cm) were available together with radio spectrographic data. Further work was done on the role of acceleration in electric double layers to explain the phenomenon of impulsive bursts.

Achterberg and Kuijpers completed a study of fast particle diffusion in the presence of low-frequency mhd turbulence and applied the results to a longlasting post-flare soft X-ray and radio arch observed with HXIS.

Den Rooijen en Kuijpers started an investigation of the magnetic field structure and the ionization of an infalling gas cloud characteristic for T Tauri stars.

Kuijpers, Van der Hulst, De Landtsheer and Heintze started simultaneous radio (WSRT) and UV (IUE) observations of flares of RS CVn stars.

Kaastra and Langerwerf constructed a reduction program to derive the properties of impulsive radio bursts observed with the WSRT in the 0.1 s solar mode.

Martens wrote a review on nonlinear dynamics in astrophysics. Further he completed his Ph.D. thesis on instabilities and nonlinear oscillations in stellar coronae and coronal loops.

Kaastra investigated the problem of particle runaway in strong electric fields. For weak fields he found stability of a plasma near the onset of electron runaway. Further he reduced observations of a large flare and found the presence of fast and strong electron runaway. This runaway can be explained as direct electric field acceleration by large electric fields.

Submmm/mm research

Research on infrared object with submm and mm spectroscopy.

Staff: H. Nieuwenhuijzen, H. van de Stadt.

Collaborating groups:
-- Astronomy Division of ESTeC (ESA), Noordwijk
-- Astronomical Institute, Amsterdam
-- Astronomical Institute, Leiden
-- Radio observatory, Dwingeloo
-- Rutherford Appleton Laboratories, Chilton, England.

Observations were carried out in Chile (ESO) with the ESTeC-Utrecht heterodyne receiver at a wavelength of 1.3 mm, which is the J=2-1 transition of carbonmonoxide (Figure 11). The Magellanic clouds were observed with the 3.6 m telescope (8 days and nights). The 1.5 m CAT-telescope was used for four months mainly during daytime. The following objects were observed: a CO-survey of the southern galactic plane for galactic lengths between 260° and 355°; mapping of molecular clouds associated with HII regions (several RCW-sources and areas in the Ara and Carina OB-associations); mapping of the dark clouds L1642, L1645 and Coalsack; several globules and VBH-sources. Several articles are in preparation. Due to a rather low telescope efficiency (36%) of the CAT at 1.3 mm wavelength, and due to disturbing instrumental baselines we decided to stop measurements with the CAT by the end of July 1982.

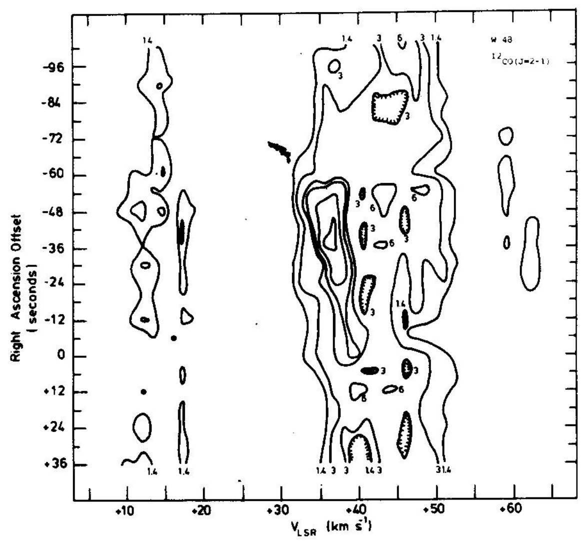


Fig. 11: Stripscan through W48 at declination +01°08'00"; plot of right ascension offset against velocity. Offsets are with respect to right ascension 18:59:15 (1950.0)

Several projects are carried out in cooperation with British observatories as part of the UK-NL collaboration:
1. In cooperation with the university workshop of Utrecht and the radio observatory in Dwingeloo a chopping secondary mirror was built for the UKIRT telescope in Hawaii. Mechanical and electrical parts were completed in November 1982 and were successfully tested at the telescope in Hawaii by the end of the year.
2. The Acousto-optic-spectrometer was tested in 1982 and showed several deficiencies, that will be mended by using a stronger HeNe laser. The spectrometer will be used as a backend for the common user submm heterodyne receiver, which is being built in collaboration with Dwingeloo for use at UKIRT.

3. Since September 1, 1982, Van de Stadt is working for 50% of his time at the Rutherford-Appleton Laboratories, Chilton, England to design a chopping secondary mirror for the 15 meter diameter telescope for the mm-wavelength region. Construction of the mirror system may be arranged for in the university workshop in Utrecht. The telescope is scheduled to be finished in 1986 and from then on 20% of the total observing time will be available for Dutch astronomers.

3.2. SPACE RESEARCH LABORATORY

Solar Research

In 1982 two main activities dominated in this research field: (1) Evaluation and interpretation of the observational data obtained by the HXIS (Hard X-ray Imaging Spectrometer) aboard the SMM satellite in 1980, and (2) Preparations for the repair of the SMM spacecraft and revival of its experiments in 1984. In addition to it, some preliminary studies have been made for new projects of solar X-ray studies.

Staff: H.F. van Beek, A. Boelee (parttime), A. Duijveman, P. Hoyng, C. de Jager, R. Mewe, G.H.J. van den Oord, A. Schadee, J. Schrijver and Z. Svestka.
Guest investigators: J. Jakimiec, M.E. Machado and B.V. Somov.
Technical coworker: M.Y. Galama.

Cooperating institutions:
- University of Birmingham, Department of Space Research, England
- University of California, San Diego, CA, USA
- University of Wrocław, Poland
- Laboratory for Astronomy and Solar Physics, GSFC, Greenbelt, MD, USA
- American Science and Engineering, Cambridge, MA, USA
- Los Alamos Scientific Laboratories, New Mexico, USA
- Observatorio de Fisica Cosmica, CNIE San Miguel, Argentina
- Department of Astronomy, University of Glasgow, Scotland
- Solar Astronomy, Caltech, CA, USA
- Division of Radiophysics, CSIRO, Epping, NSW, Australia
- P.N. Lebedev Physical Institute, Moscow, USSR
- Berkeley Research Associates, Berkeley, CA, USA
- Observatoire de Meudon, Meudon, France
- Mullard Space Science Laboratory, Univ. Coll. London, Holmbury St. Mary, Dorking, England
- Lockheed Palo Alto Research Labs., Palo Alto, California, USA
- Rutherford and Appleton Labs., Chilton, Oxfordshire, England
- P.N. Lebedev Institute of the Academy of Science, Moscow, USSR
- Max-Planck-Institut für Radioastronomie, Bonn, FRG
- Radio-astronomisches Institut der Universität, Bonn, FRG.

1. Interpretation of the HXIS Data

Impulsive burst heating, a chromospheric explosion and convection in the flare of 12 November 1980; 02:50 UT

This flare, that was studied on the basis of HXIS data by Boelee and De Jager is a schoolclass example of impulsive burst heating followed by convection. The observations show that in all HXIS energy-channels a number of bursts occurred between 02:44 and 02:53 UT. These bursts were emitted from a limited area on the Sun, but within that area the various bursts had adjacent, but different source regions. There was simultaneous emission from another small area, at $\sim$ 40 000 km distance. This suggests successive excitation of adjacent, but different loops (Figure 12). A new feature is that for at least one burst the source region spread out from an initially small area over a larger one, with a velocity of propagation of $\approx$ 50 km s^{-1}; this is interpreted as a chromospheric explosion (Figure 13). During the period of burst occurrence there was a practically constant net average exponential heat input. This period is defined as the phase of impulsive burst heating.

Already in the early part of the impulsive phase hot plasma spread out laterally, thus forming a diffuse extended cloud. In that phase the diffuse component of the flare was still a few million K hotter than the average temperature of the impulsive component, a value that is consistent with elementary convection theory. Hence the impulsive and gradual phases of a flare are not separate events but they overlap.

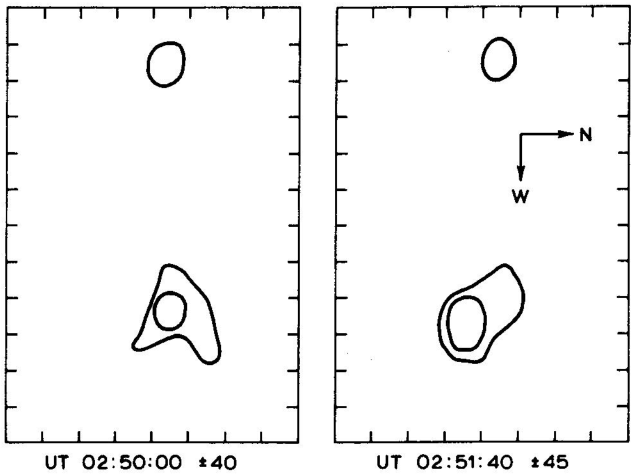


Fig. 12: *Sources of two hard bursts during the flare of 12 November 1980. The observations are made in energy bands IV + V of HXIS (11 to 22 keV). Isophotes correspond to 0.6 and 1.2 counts s^{-1} (≈ 4σ and 8σ). The western source changes position during the two bursts, suggesting successive excitation of adjacent but different loops. The distance between two ticks along the ordinates corresponds with 8".*

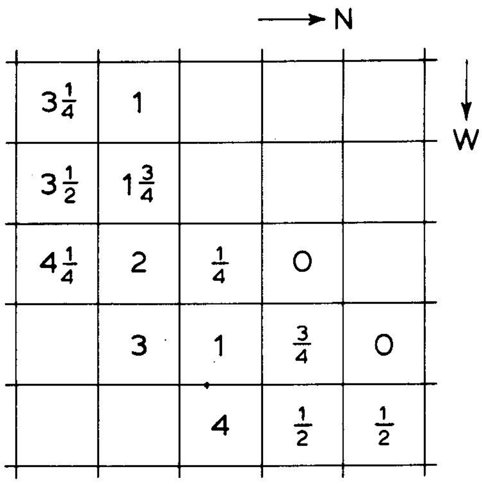


Fig. 13: *A propagating flare burst following a chromospheric explosion. The Figure gives for a part of the HXIS field of view the time difference in minutes between the times of maximum X-ray flux with regard to the time of maximum in the two pixels where the burst originated and had highest intensity. This suggests wavelike propagation of the burst, with a velocity of ≈ 50 km s^{-1}. Squares denote HXIS pixels (8"x8").*

Evolution of a flaring loop after injection of energetic electrons

The November 5, 1980 flare (22:30 UT) showed a large flaring loop, spanning about the entire fine field of view of HXIS. From the hard X-ray signatures of the flare during the impulsive phase it has been concluded that fast electrons precipitate into the dense atmospheric layers at the location of the footpoints of the loop. Duijveman, Somov (Moscow) and Spektor (Riga) investigated the response of the chromosphere and the corona to the injection of the beam electrons. From a numerical simulation they concluded that most of the absorbed beam energy would be radiated in the transition zone between corona and chromosphere, while only a small fraction ($\approx$ 3%) would be used to evaporate material from the chromosphere (upward velocities $\approx$ 50 km s^{-1}). Comparison of the observed response with the computed response shows that the injected beam energy is insufficient to explain the observed density increase by the action of the beam alone. Additional energy and/or mass input is required. Van den Oord, Duijveman and Hoyng also studied the energy budget of this loop as a function of time on a long-time scale.

The start of a flare

Detailed investigation of the 'Queens' Flare' (30 April 1980; 20:20 UT) and its precursors by De Jager, Schadee, Svestka, Van Tend, Machado, Strong and Woodgate showed that the first X-ray emission of this limb flare could be observed at about 10^{-3} of the flare's maximum intensity about 5 min. before the start of the flare in other wavelength bands. This emission occurred at the top of a small loop, presumably at the place where this loop reconnected with a larger loop, after previous flare emergence. A few minutes later the legs of the small loop were filled with energetic electrons, while at virtually the same time the larger loop was also filled with energetic electrons, presumably by convection. Hence this flare shows: reconnection and primary emission in the top of the loop, followed by footpoint (actually: leg) heating, followed by convection.

Coronal flares

As mentioned in the last Annual Report (Jaarverslag 1981), HXIS recorded on 6 November 1980 strong quasi-periodic X-ray variations which had no counterpart in the chromosphere. Somov and Svestka demonstrated that the X-ray flux in these variations was so strong that the chromosphere should have been excited by heat conduction to flare intensity. Since no trace of any chromospheric excitation was seen, Svestka et al. suggest the configuration shown in Figure 14: after the flare reconnection process some field lines are disconnected from the lower-lying magnetic field. Electrons, accelerated high in the corona and causing there metric radio bursts, stream downwards along the field lines and produce the observed X-ray emission in the lowest part of the closed plasmoid. The lower atmospheric layers are not excited, because there is no magnetic connection between them and the variable structure.

X-ray emission in absence of flares

Schadee, De Jager and Svestka have demonstrated that there is a variety of phenomena in the solar corona other than flares which are recognizable sources of X-rays above 3.5 keV. (cf. Figure 1). Emission from these sources is usually very weak, but it definitely requires coronal temperatures in excess of 6 million degrees.

The fact that such high temperatures occur frequently in the absence of flares is new. Characteristics of this very hot plasma and its time variations are different in active regions of different age and development phase. In young active regions one finds a great number of 'microflares' with a wide range of intensities, down to 10^{-3} times the normal count rate in a flare. In old regions, long-lived enhancements prevail, lasting up to 10 hours with intensities $\sim 10^{-4}$ times smaller than in flares. In some cases the occurrence of such hot plasma may be related to a later occurrence of flares.

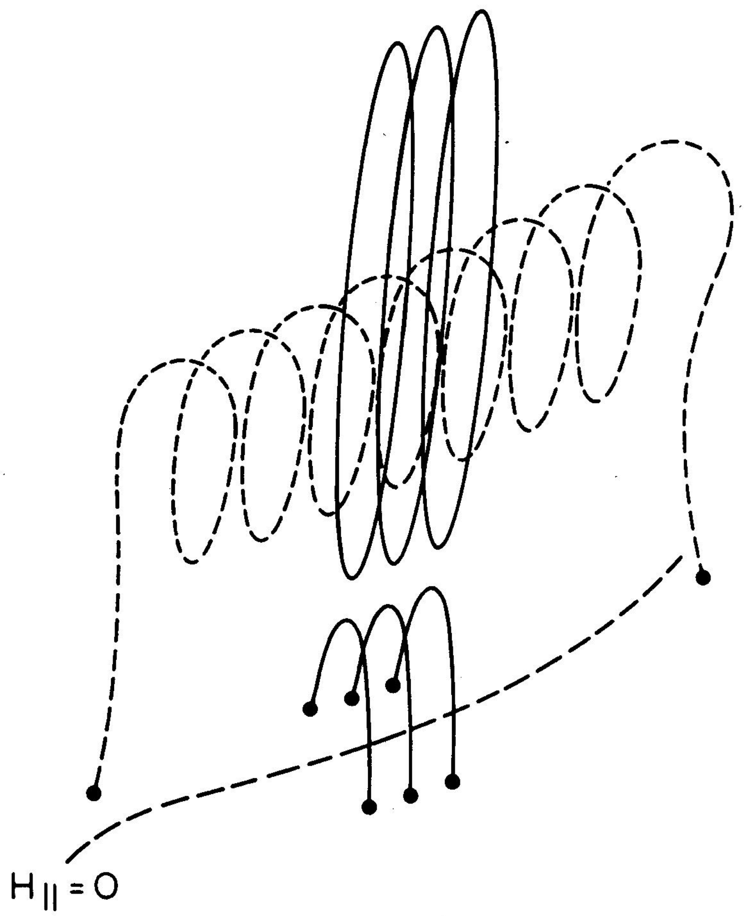


Fig. 14: As the distended magnetic field lines reconnect in a flare, flare loops are formed below and upper loops (dashed) above. The upper loops are interconnected because of a shear in the original magnetic field. However, later in the flare development, the shear disappears and the reconnection process forms isolated closed upper loops (full curves). A group of such closed loops may form a plasmoid in which coronal brightness variations occur. These variations have no counterpart in the chromosphere, because there is no magnetic connection between the plasmoid and the lower atmospheric layers.

Ionization diagnostics of solar flare plasmas

In collaboration with the SMM experimenters (Sylwester, Strong, Bentley) Mewe and Schrijver continued the analysis of large flares observed with the Bent Crystal Spectrometer (BCS) in the SMM satellite using a program that determines ion concentrations and tests deviations from ionization equilibrium. For about 25 flares relative concentrations of the ions Fe^{+25} to Fe^{+20} and Ca^{+18} and Ca^{+17} were derived with a typical time resolution of 10-60 sec and plotted against measured electron temperature. Since most of the points will probably correspond to quasi-stationary ionization conditions (gradual rise and decay of temperature), a calibration curve results, which generally compares very well with the theoretical ionization vs. temperature relation after properly updating the atomic rate coefficients for excitation and ionization. On the other hand, data points arising from transient ionization conditions would stand out. The results of the analysis performed on a few BCS channels appear not to indicate measurable (at > 3 sigma level) transient conditions. For some selected flares and time intervals the study will be extended (in collaboration also with Jakimiec and Culhane) to other, more sensitive channels of the BCS.

2. Technological developments

HXIS/SMM repair activities

For the preparation of the repair and the repair activities themselves NASA made funds available in 1982. The repair will take place in space aboard the space shuttle. As to make HXIS capable of operating again, the data handling electronics, failing since June 1981, ought to be exchanged. This turns out to be impossible for practical reasons. Therefore, software program preparation was started in order to do failure analysis which may lead to reactivation of at least one of the two micro-processors later on. If this analysis is successful NASA will attach a thermal foil over the HXIS aperture in order to eliminate a temperature problem that has occurred. Without this foil the X-ray transmission of the collimator could have been deteriorated. The true degree of deterioration can only be established after the spacecraft has been brought back in operation. Most important repair on the SMM itself concerns the attitude system. An additional problem with the spacecraft at this moment is related to one of the batteries.

SOHO

In collaboration with a number of colleague institutes in Europe a proposal to ESA has been submitted for a future mission called: 'Solar High Resolution Observatory'. The aim of this mission is to study processes in the solar corona and chromosphere. The spacecraft instrument package consists of two spectrometers in the wavelength range 9-130 nm, an EUV telescope and a coronograph. Out of 20 proposals this proposal has been chosen, together with four others, to be subjected to a further study (assessment study) to be performed in 1983.

The DISCO Project

In 1982, the Laboratory became involved in an instrument study for the High Resolution Spectrograph, the key instrument from the model payload of DISCO. DISCO is one of the five missions for which ESA conducted a phase-A study in 1982. The object of the HRS is to measure the period and velocity amplitude of solar global oscillations of low spatial structure ($\ell \leqslant 4$). The study was carried out in collaboration with the Observatoire de Nice (Dr. Delache) and the Laboratoire de Physique Stellaire et Planetaire (Dr. Bonnet). The following items were studied by SRL (Hoyng and Van Genechten):
- Design shielding and stability of a low-mass 5000 G magnet. Numerical simulations were made by Ugimag Recoma AG (Lupfig/Switzerland).
- Thermal isolation and mechanical support of the sodium absorption cell (at 458 K) in the magnet. The solution proposed is an adaptation of the method that was successfully employed to support the collimator of the HXIS instrument aboard the Solar Maximum Mission.

An international workshop 'The Global Sun and the Heliosphere as seen from the Lagrange Point' was held at Utrecht on 22 and 23 June. For Utrecht, De Jager, Negenborn and Hoyng took part in the organization. The object of the workshop was to provide an open forum for scientific discussion during the phase-A study of DISCO.

GRIST

Under ESA contract, a study has been performed in collaboration with TPD (Delft) concerning a grazing incidence focal plane instrument. Wavelength range: 6.5 - 175 nm. Spectral resolution: varying from 0.003 to 0.0075 nm. Grazing incidence technology is used all over, for mirrors and gratings, as to achieve a high efficiency over a wide wavelength range.

Pinhole/Occulter Facility (POF)

For the Pinhole/Occulter Facility, via the membership of the NASA Science Working Group (Van Beek), a contribution was made for the preparation of a limited phase-A study, to be performed in 1983. This study will be done by Marshall Space Flight Center and the members of the SWG. Technological contributions from SRL concerned the project in general, details about the X-ray detector system, and the alignment and aspect sensing system. For the latter, basic schemes could be defined.

Ultraviolet stellar spectroscopy

This field comprises observations and interpretation of high resolution ultraviolet stellar spectra. Spectra were obtained with the NASA-SRL BUSS instrument and with the International Ultraviolet Explorer (IUE).

Staff: R. Hoekstra, K.A. van der Hucht, C. de Jager, T.M. Kamperman, H.J.G.L.M. Lamers, T. Wijchers.
Technical coworkers: T.E. d'Arnaud, G.J. van Dijen, W.C.A. van Dijkhuizen, M.Y. Galama, J. van Hal, M. van der Linden, A.G.W. Maas, R. van der Meij, E.W.P. Schrijvers, F.R. Werkhoven.

Collaborating institutions in the BUSS project:
-- Astrofysisch Instituut, V.U.B., Brussels, Belgium
-- Institut d'Astrophysique, Université de Mons, Belgium
-- NASA Goddard Space Flight Center, Greenbelt, MD, USA
-- Physics Department, South Western University, Georgetown, Texas, USA
-- Laboratory for Atmospheric and Space Physics, University of Colorado, Boulder, CO, USA

Other collaborating institutions:
-- Observatorium Bosscha, Institut Technology Bandung, Indonesia
-- European Southern Observatory, La Silla, Chile
-- UKIRT Observatory, Hilo, Hawaii, USA
-- Joint Institute for Laboratory Astrophysics, University of Colorado, Boulder, CO, USA
-- Department of Physics and Astronomy, UCL, London, UK
-- Lund Observatory, Lund, Sweden
-- Washburn Observatory, University of Wisconsin, Madison, WI, USA
-- Sterrenkundig Instituut Anton Pannekoek, Universiteit van Amsterdam
-- Laboratorium voor Ruimteonderzoek, Rijksuniversiteit Groningen
-- Sterrewacht te Leiden, Rijksuniversiteit Leiden

BUSS (2000-3000 Å, $\Delta\lambda \approx 0.1$ Å)

Five publications based on BUSS observations, which were obtained in 1976 and 1978 appeared in print in 1982. 'The mid-ultraviolet spectrum of ε Aurigae' (Astron. Astrophys. Suppl. *50*, 233 (1982)), 'The photospheric velocity field of Procyon'(Astrophys. Space Sci. *84*, 297 (1982)), and 'Ultraviolet emission in the Mg II h & k lines in Be-stars' (Astrophys. J. *262*, 675 (1982)) were mentioned in the previous Annual Report. BUSS observations of α Cyg (A2Ia) were used to derive the mass loss rate of this supergiant (Astron. Astrophys. *106*, 137 (1982)).

The low excitation Fe II lines in the spectral region 2000-3000 Å, arising from the ^6D and ^4F levels, have been studied in the spectrum of α Cyg. Calculations with the Sobolev approximation (with the 'underlying photospheric spectrum' treated as a lower boundary condition) favour a stellar wind model characterized by an outflow velocity v which increases steeply up to v_∞ = 240 km s^{-1} and an optical depth dependence proportional to $(1-v/v_\infty)^{1.2}$. At least 11% of all iron in the wind is once ionized, unless a non-thermal heating source enhances the fraction Fe^{++} without destroying much Al^+. The mass loss rate corresponding to this model is 1 to 5 x 10^{-9} $M_\odot$ yr^{-1}. This rate is one order of magnitude smaller than the rate 1 to 8 x 10^{-8} $M_\odot$ yr^{-1} derived by Lamers et al. (1978) from their curve of growth analysis. It is shown that the contribution of blending photospheric absorption lines (e.g. Co II) to *weaker* P Cygni profiles has been largely underestimated previously.

Also, work is in progress to study the dynamical state of the atmospheres of the supergiants α Cyg and α Per on the basis of the BUSS spectra.

BUSS observations of α CMi (F5 IV-V) were used (Bull. d'Inf. de C.D.S. *23*, 45 (1982)) for the continuing study of this star. As a first approach to a full identification and discussion the region 3150-3230 Å was investigated. This wavelength region had been observed from the ground by Griffin (1979) by inferior means. To identify the spectral lines a synthetic spectrum was calculated in LTE (KP model (6500,4)). It appeared that log gf values of Fe I are rather uncertain and that elements with $Z > 41$ are underabundant, or have too high log gf values in the literature.
The work on Procyon as well as on the Be stars is continuing.

The BUSS flight of 4 October 1982

Much time and effort was spent in 1982 on the preparations for the BUSS flight on October 4, 1982. A new echelle spectrograph ($\Delta\lambda \approx 0.03$ Å) was built behind the BUSS telescope. Plans for the use of a Multi-Anode Microchannel Array (MAMA), provided by our U.S. partner (LASP) had to be dropped because of technical problems. Therefore the available SEC-Vidicon camera, used also on previous flights, was used as detector. For the first time the complete BUSS gondola and instrument were transported to Utrecht, where all the mechanical, electronical and optical work was done. Financial support was received from our Belgium partners (Universities of Mons and Brussels). In July all the instrumentation and a complete ground station were shipped to NCAR, Palestine, Texas, USA, and during these months BUSS and the groundstation were assembled and tested for flight. In the night of October 4 BUSS reached its record in altitude ($h > 42$ km) and registered 16 spectra of 11 stars. Due to a malfunction of the stabilization system, a pointing jitter affected the width of the spectral orders and the dispersion. Currently, image processing techniques are applied to convert the echellograms into flux versus wavelengths plots.
Interpretation of the 1976-1978 BUSS data is continuing.
Preparations for a BUSS flight in fall 1983 are in progress.

IUE

During one shift a high resolution spectrum of a $10^m.6$ WC9 star was obtained, as a part of a comprehensive study of late WC stars. It was found again, as in two other WC9 stars (IAU Symp. No. 99, p. 277), that v(Fe III)/v_{edge}(C IV) ≈ 0.6. The study of the location in the stellar wind of the Fe^{++} ions is in progress. For this study observations in the IR spectral region were obtained as well (see below).

Wolf-Rayet stars

In collaboration with scientists in Amsterdam, Groningen, Leiden and Hawaii, optical and infrared photometry and spectrophotometry of late WC stars was obtained at ESO and UKIRT. With data now extending from the UV into the IR the energy distribution of these stars is being investigated, notably the thermal infrared excess around 10 μm emitted by circumstellar dust shells. A possible connection between the circumstellar dust and the Fe III absorption found in the UV is being investigated.
In collaboration with scientists in Lembang (Indonesia) the study of the galactic distribution of WR stars is continued. With improved intrinsical parameters provided by collaborators in Lund (Sweden) the photometric distances of the WR stars are rediscussed. Comparison is being made with the galactic distribution of other Pop.I objects.
In collaboration with scientists in London and Boulder an atlas of high resolution IUE spectra of Wolf-Rayet Stars is in preparation.

Shock-driven winds in Beta Cephei stars

The β Cep stars BW Vul and σ Sco, of which IUE spectra had been obtained in previous years show transient stellar wind components, apparently associated with impulsive acceleration of the photospheres and outer layers. The dynamical and thermodynamical behaviour of the outer layers is currently being investigated in order to study the phenomenon of shock-driven stellar winds. It seems that it makes sense to consider the analogy with similar phenomena in supernovae.

Physics of the interplanetary medium and the magnetosphere

The field of research comprises the phenomenology and the mechanisms involved in propagation, acceleration and diffusion of energetic particles in the interplanetary medium. The observational material consists of energy spectra and directional distributions of the particles as measured with the instrument ISEE-3/DFH (S410) aboard the 'International Sun-Earth Explorer-3', which was launched in 1978.

Staff: J.J. van Rooijen, G.A. Stevens.
Technical coworkers: G.J. van Dijen, P. Lowes, G.J. Wiersma.

Collaborating groups:
-- Imperial College of Science and Technology, London, England
-- Space Science Department, ESTeC, Noordwijk.

Investigations

The investigations into the potentialities of a 'maximum entropy approximation' of the distribution function, with a view to the modelling of propagation and acceleration of charged particles, was continued. It turns out that a closed system of rate equations for the lowest order moments in the coordinates $\underset{\sim}{x}$, $\underset{\sim}{v}$ can be found. There are, however, still some complications if one tries to reproduce similar results in the solar wind frame in order to arrive at an adequate reference solution, a numerical simulation for simple cases is presently being set up.

The ISEE 'extended mission' scenario

The 10th of June 1982 was a turning point in the history of the ISEE-3-mission. The nominal three-year mission duration, in which the spacecraft was constrained to the vicinity of the libration point L_1, was formally terminated in August 1981. Thereafter, data tracking was continued, but meanwhile the ISEE-3 community was in the process of defining a valuable 'extended mission' scenario, guided by the considerable fuel resources for operating the hydrazine thrusters. It was finally decided that the spacecraft should explore the magnetotail (Figure 15). The ISEE-3 is considered to have adequate instrumentation aboard for this exploratory mission extension, and it is firmly believed that the spacecraft will return valuable data on the physical processes in the magnetotail. The major portion of these data will become available in 1983.

The departure from the original halo orbit in the direction of the libration point L_3 was initiated on the 10th of June 1982. Prior to the magnetotail crossings, the spacecraft will also traverse the bow-shock region which is believed to be a potential source of 'upstream particle events'. Earlier, proton populations of this kind were observed far from the bow-shock in interplanetary space. There is a possibility that suitable data become available for in situ studies of source characteristics.

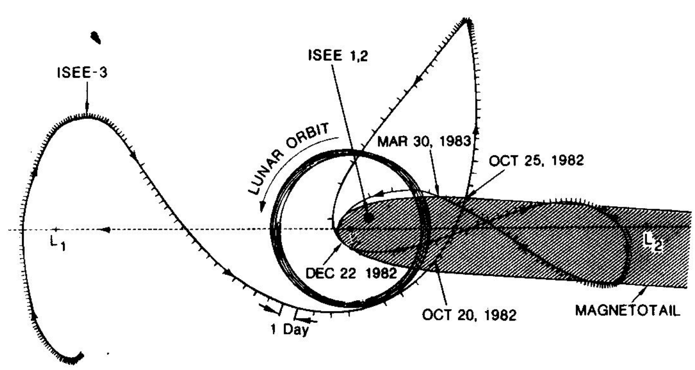


Fig. 15: ISEE Extended Mission Trajectories.

Cosmic X-radiation

This topic refers to the observation and interpretation of X-radiation of cosmic objects measured with the spectrometer aboard HEAO-2 (Einstein Observatory); the preparation of X-ray experiments in the satellites EXOSAT, the International Solar Polar Mission, and Salyut 7; preparatory studies for new projects.

Staff: A.J.F. den Boggende, A.C. Brinkman, J.H. Dijkstra, E.H.B.M. Gronenschild, J. Heise, R. Mewe, J.J. van Rooijen, J. Schrijver.
Technical coworkers: H.B. Buurmans, W.J.M. van Dijk, W.F.P.A.L. Geerlings, H. Goulooze, P.J. de Groene, M.A. Hilhorst, A.G. van der Horst, P. van Kralingen, P. Lowes, C.W.G.M. du Maine, W.A. Mels, A.P. Naber, T.M.J. Peters, F.A. van Rooijen, A. Rook, M.J. Rijnsent, C. Timmerman, K. Veldkamp, W. Zandee.

Cooperating institutions:
-- Smithsonian Astrophysical Observatory, Cambridge, Mass., USA
-- Department of Space Research, University of Birmingham, England
-- Werkgroep Kosmische Straling, Leiden
-- Centre d'Etude Spatiale, Toulouse, France
-- Mullard Space Science Laboratory, London, England
-- Max Planck Institut für Extraterrestrische Physik, München, FRG
-- Observatoire Astrophysique de Meudon, France
-- Space Science Laboratory, Berkeley, USA
-- Space Science Department, ESTeC, Noordwijk
-- NASA, Goddard Space Flight Center, Greenbelt, MD, USA
-- IKI, Institute for Space Research, Moscow, USSR

1. Scientific research

Cataclysmic variables

The cataclysmic variable AM Herculis is the prototype of a growing subclass of these objects that are called 'AM Her type objects', 'White dwarf magnetic binaries' or 'Polars'. They are characterized by a large magnetic field (> 10^7 gauss). The accreted massflow onto the white dwarf is channeled along the field lines. Theoretical models to describe the accretion use a segment of spherical accretion models. The polars are the test case for these type of models. The models predict the occurrence of a standing strong shock near the white dwarf. The hot 'settling' atmosphere between the shock and the white dwarf photosphere radiates as thermal bremsstrahlung in the hard X-ray range (10-100 keV). Half of this radiation is absorbed by the photosphere and reradiated as soft X-rays (10-100 eV). Thus the model predicts an equal luminosity in the hard and soft X-ray range. Soft X-ray observations with proportional counters, however, indicated thus far a soft X-ray luminosity which is a factor of 10 to 1000 larger than the hard X-ray luminosity.

This source was observed with the Objective Grating Spectrometer aboard the Einstein observatory in order to determine an accurate spectrum in the soft X-ray range. Theoretical continuum spectra obtained from plane parallel layers in radiative equilibrium were fitted with constant flux ('model')atmospheres to this data. Using the UV spectra known from IUE, it appeared possible to obtain satisfactory fits. The implied total luminosity is now only 10 times the hard X-ray flux. This discrepancy could be explained by the model of Kuijpers and Pringle, who consider inhomogeneities in the accretion flow. Gas blobs of higher density would penetrate deeper into the photosphere and thus carrying part of the accretion energy directly into the optical thick region.

Coronal and chromospheric activity of F-, G- and K-type stars

In the solar atmosphere the areas with chromospheric line emission are cospatial with areas with strong magnetic fields. This suggests that the emission flux in chromospheric lines can be used as a measure of the level of magnetic activity. Most of the solar X-ray flux originates from coronal condensations over active regions, and therefore it may be considered to be an activity measure as well. That other late-type stars show similar relations between chromospheric and coronal emissions is confirmed by the crude correlation between F_X and F_{H+K} found by Mewe and Zwaan. The correlation is strongly improved if the Ca II flux F_{H+K} is replaced by the Ca II excess flux ΔF_{H+K}, which is defined as the line-core flux above an observational lower limit in the diagram of F_{H+K} versus (B-V). This lower limit depends on (B-V) and luminosity class.

The sample of stars (observed with the HEAO-2 Einstein Observatory by Mewe, Schrijver and Zwaan), containing dwarfs and giants, was subjected to a multidimensional common-factor analysis. The parameters used are the soft X-ray flux density at the stellar surface F_X, the Ca II H+K line-core flux density F_{H+K}, and parameters determining the stellar interior.

The analyses show that the relation between coronal and chromospheric activity is unaffected by parameters determining the internal stellar structure, such as the stellar mass and radius. (Note, however, that the relation between F_X and F_{H+K} may depend on the chemical composition, since the lower limit in F_{H+K} depends on it.) All stars in the sample, single dwarfs and giants, and components of binaries, follow the same relation (see Figure 16): $F_X = 3.4\ 10^5\ \Delta F_{H+K}{}^{1.67}$. (1)
It is suggested that the Ca II lower-limit flux is uncorrelated to the part of the magnetic structure that produces hot coronal loops emitting X-rays. Possibly the Ca II lower-limit flux originates from the non-magnetic parts of the atmosphere, as well as from magnetic elements comparable to the Solar quiet network structure in coronal holes. The Ca II excess flux ΔF_{H+K} is a measure for the fraction of the area covered with footpoints of X-ray emitting loops. If only the number of X-ray emitting features would change with ΔF_{H+K} a linear relation would result between F_X and ΔF_{H+K}. As the exponent in the relation is larger than unity the average structure of the X-ray emitting, magnetic features must change with changing activity. The fact that the Sun, during its activity cycle, also follows the above relation may indicate that the same structural changes occur in time on the Sun as are observed for stars with different average levels of activity.

As the relation between the stellar coronal and chromospheric fluxes appears to be unaffected by the internal stellar structure, we conclude that a single 'activity parameter', varying along the relation, uniquely determines the average flux levels of the outer atmosphere. The parameters presently included in the analysis, or equivalent ones, do not, by themselves, determine the actual value of the activity parameter. It is thought that the stellar rotation rate is of major importance in studies concerning the activity parameter.

X-ray spectra, obtained with the IPC aboard Einstein, were also analysed. For a rather limited sample of stars we find a significant separation of dwarfs and giants: typical coronal temperatures for dwarfs are around 2 MK, for giants around 10 MK. Application of models for magnetic loops showed that the data for moderately active dwarfs, like the Sun, are compatible with a corona consisting mainly of large-scale loops ($\sim$ 0.1 R), whereas the coronae of active dwarfs appear to consist of very compact loops, at least as compact as the loops in solar active regions. For giants a maximum loop length of the order of the stellar radius was derived.

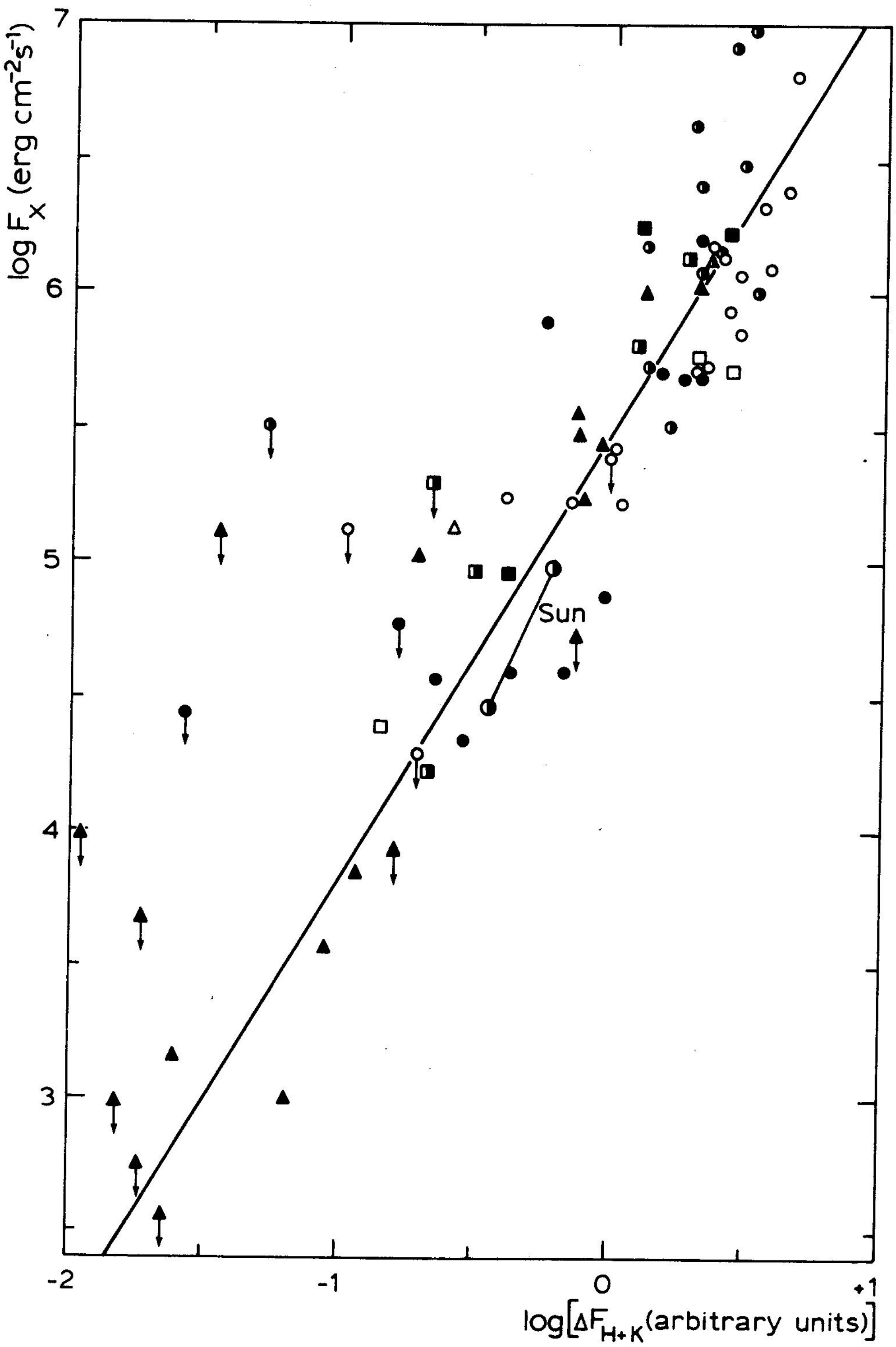


Fig. 16: *Soft X-ray flux F_x against the Ca II H+K excess flux ΔF_{H+K}. Symbols with arrowheads indicate upper-limit fluxes (not included in the analyses). The line represents the relation (1).*

L.C.	*Giants* *II-III/III*	*III-IV/IV*	*Dwarfs* *IV-V/V*
$B - V \leq 0.6$	△	□	○
$0.6 < B - V \leq 0.8$	◭	◧	◐
$0.8 < B - V$	▲	■	●

2. Preparation of new experiments

The ESA satellite EXOSAT

The year 1982 did not bring the long awaited launch of EXOSAT. Due to technical difficulties with the Ariane launcher, the launch scheduled for November had to be postponed.

Early in the year the 1000 l/mm gratings produced in Utrecht were delivered to ESA and integrated in the low energy experiment. Package calibration of different filters, to be put in front of the detectors, continued and is still going on for a set of spare filters.

Due to redefinition of some X-ray filters, new calibration measurements were required. From transmission data at five different wavelengths the thickness variations over the filter area were deduced, showing that most of the filters are homogeneous within the error range. Independent thickness measurements were carried out for some filter materials by the 'Vakgroep Algemene Chemie, afdeling Structuur Chemie' in order to obtain an acceptable set of X-ray absorption coefficients, necessary to give the absorption of the filters over the whole range of interest.

The main effort from the laboratory in 1982 went into the reduction of calibration test data from several long beam tests and the preparation of data reduction software. As an example of calibration data, Fig. 17a shows the response of the grating spectrometer to a narrow EUV-line at 171 Å. The central peak is the zero-order response and the left and the right are the plus and minus first orders. Nearly a hundred calibration measurements were carried out with the 1000 l/mm and 500 l/mm gratings, using the channel multiplier array as the detector. These measurements were done using seven different wavelengths, sources between 7.1 Å and 67.6 Å and with another six long wavelength EUV lines between 160 and 584 Å. Fig. 17b shows the response of the 500 l/mm grating spectrometer to the 7.1 Å source. As the source input spectrum was used SiO_2 radiation of which the low energy oxygen component was filtered out. In addition to the first order, the higher orders are clearly visible.

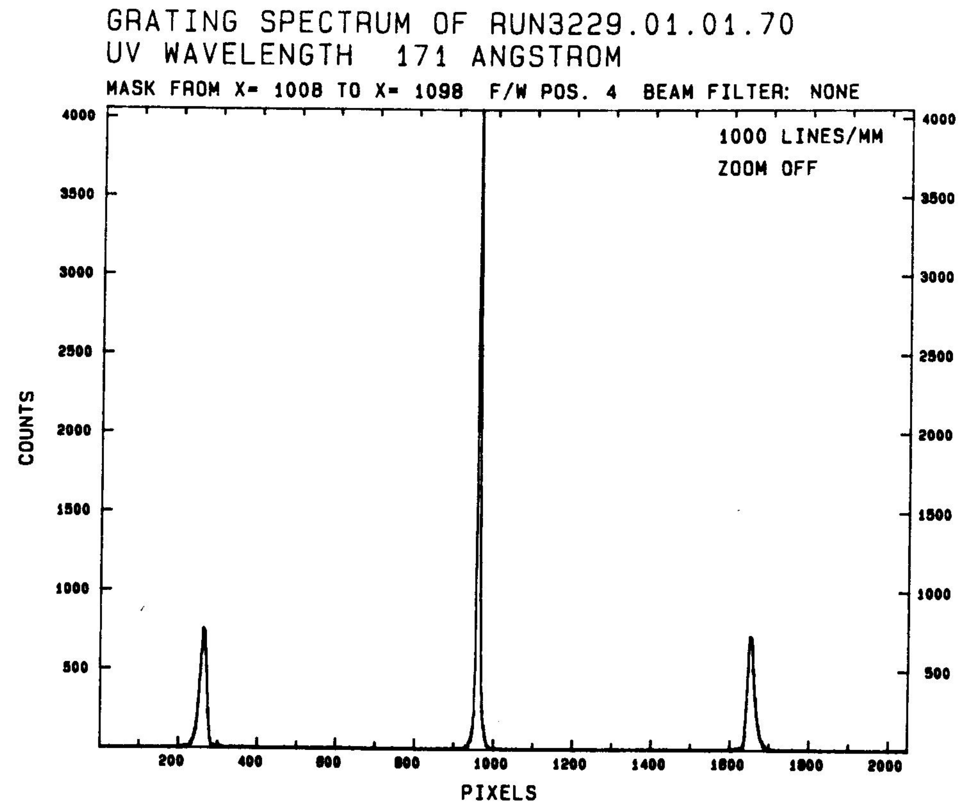
The preparation of software for data handling and data analyses is being prepared in collaboration with the other groups involved and particularly so with the group in Leiden.

COMIS (Coded Mask Imaging Spectrometer)

COMIS is an X-ray spectrometer in the energy range between 2 and 25 keV. It will have a spatial resolution of a few arcminutes and a field of view of 7 degrees (full width at half maximum), the spectral resolution is 20% at 6 keV. The instrument will be installed in a scientific module which will be attached to the Salyut 7 spacestation by late 1984, early 1985. The intended minimum operational period will be one year. The resulting scientific data will be analyzed jointly by IKI (Institute for Space Research, at Moscow) and by Utrecht and collaborators.

The detector is a position sensitive proportional counter with a position resolution of 0.5 mm. The sensitive area is 25 x 25 cm. In front of the detector at a distance of 1.8 m there is a coded aperture plate (mask). The open area of the mask is 50% and the hole size about 1 mm. By correlating (on the ground) the recorded shadow pattern in the detector, with the mask pattern one can reconstruct the position and intensity of celestial X-ray sources.

The main scientific aim of the instrument is to study transient and bursting X-ray sources and to make light curves of a large number of strong sources over a period of more than a year. Of particular interest will be the study of the galactic center region. In addition extended objects such as clusters of galaxies will be studied.



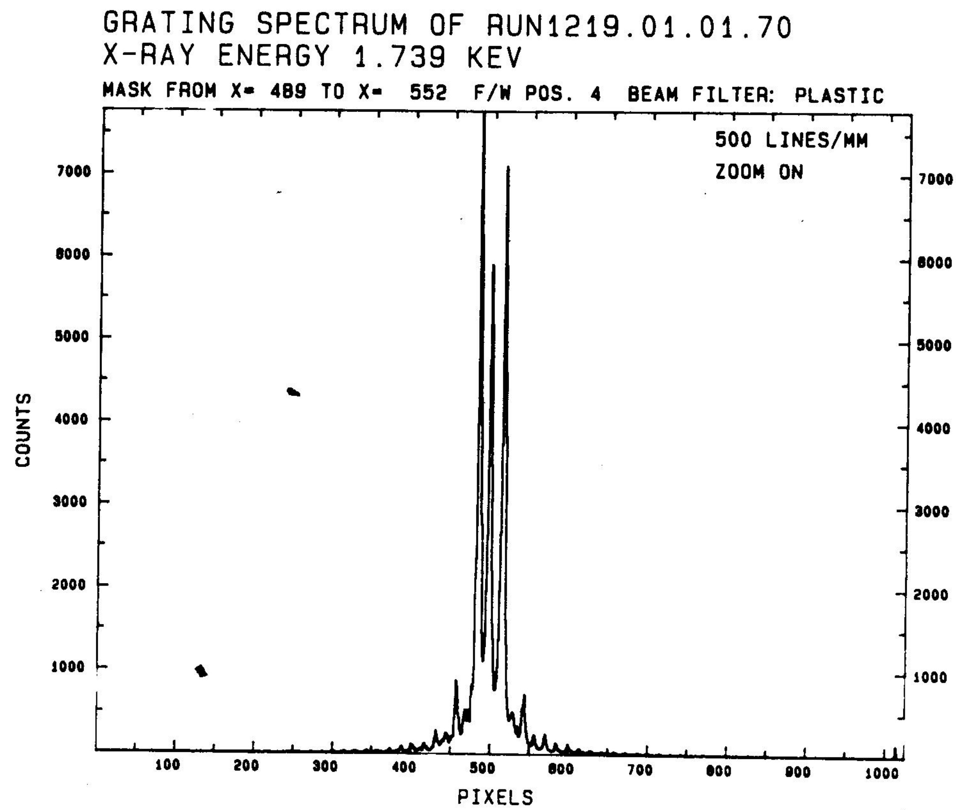


Fig. 17: Transmission of EXOSAT gratings; laboratory experiments.

The basic design of the detector has been taken from our on-going development of large area position sensitive detectors. During the second half of 1982, the main emphasis has been on translating the laboratory model into a space qualified design.

The International Solar Polar Mission of ESA

The qualification model of the satellite, completed with its various scientific instruments was subjected to the usual tests. In parallel the flight model was produced. The flight model of the monitor for soft X-radiation (5-25 keV in 5 energy channels), developed and built by the Space Research Laboratory, was successfully integrated in December 1982. Various tests have shown that the instrument can stand the low temperatures that it will acquire near Jupiter (about $-80^{o}C$). The system noise of the instrument is somewhat higher than specified.

The elimination by NASA of a similar nearly identical NASA satellite, to be launched simultaneously, will undoubtedly badly affect the scientific output of the mission. Within the ISPM-community there is some hope that the additional information, needed for completing the mission would yet be provided in the payload of a future ESA-mission such as DISCO (if ISPM is launched in 1986 the main phase of that mission, i.e. solar pole passage, would occur in 1990).

Laboratory research and contract research

Laboratory research

The final results from a study of characteristics of position sensitive proportional counters have been written down for publication. These results are presented in graphs, but the numerical ones are available on request.

The study of the characteristics of Micro Channel Plates (MCP) will concentrate on a detector configuration giving a high position resolution combined with better properties at high intensities per unit area than have been obtained so far. In principle, this type of detector can be used for the detection of radiation of various frequencies (from soft X-rays to the visible) as well as for particles. An experimental test set-up became ready, containing a detector with electronics and a computer for control and data reduction. The detector consists of two MCP's (chevron) in series with a read-out anode. The anode has a number of parallel strips of gold on a ceramic substrate. In the first phase the sizes of the charge clouds from the chevron are measured as functions of a few (experimental) parameters. In parallel a model has been developed to predict the cloud sizes to be compared with the measured ones in order to determine the values of some not well known physical quantities. These cloud sizes are the key for an ultimately attainable position resolution, and are important for the choice of the optimum read out system for this type of detector. For the next phase of the study a two-dimensional anode will be used, the preparation of which has already been started.

Contract research activities

The contract research/innovation activities were continued basically following the lines experienced since May 1981. These activities are part of the re-orientation of Dutch space research, implying that not only scientific space research shall be performed, but also contract research for industry, other institutes, etc. The purpose of this is primarily to earn money as to cover 15% of the laboratory's expenses; salaries, equipment, housekeeping, etc. Main experience was, as concluded in the beginning of 1982, that the laboratory's experience could indeed be used for a wide variety of technological problems as met by small industrial companies. However, the overhead involved in the study of these problems before a quotation can be made, is considerable. As a result, the conclusion was drawn that more specific jobs should be hunted for, more closely connected to the laboratory's experience. Two fields were recognized:
- thin-film electronic circuitry/lithography
- analog and digital electronic circuitry for handling signals of all sorts of sensors.

In addition to this, together with the 'Ministerie van Wetenschapsbeleid' three fields were indicated where experience of Dutch space research could possibly be applied. These fields are:
- aids for disabled people
- micro-gravity experiments
- instruments for remote sensing.

For the first field participation was sought with the Program Steering Committee, which considers establishing projects in this field. In addition micro-gravity experiments and remote sensing instrumentation studies were started in order to familiarize with activities underway elsewhere, and to meet institutes that could use the specific space technology experience available within the Dutch space research community.

Projects

In 1982 the Utrecht Space Research Laboratory worked on several projects for industrial companies and institutes of various sorts. The results can be summarized as follows:

-26 small studies for possible projects were done
-15 quotations were made
-work on 10 projects was started
-6 projects were finished.

Most important of all is the Hipparcos project. For this SRL is subcontracted by MATRA for the development of the detector subsystem of this ESA project. Contrary to the beginning of 1982 when two industrial consortia were competing, at the end of the year MATRA had become main contractor. Although the budgetary return in 1982 for SRL was only a few percent of the totally expected return over a few years, the involvement of the laboratory was quite considerable. Technical work on the detector system was performed and definitions for the next phase were made. Design reviews were successfully passed (see detailed description below).

The summed up return of all projects was about 0.5 Mf, very close to the expected return and as such satisfying. The four years re-orientation script for GROC prescribes that the 1983 income must be several times higher. Preparations were made to realize this requirement.

Hipparcos hardware

During 1982 SRL has participated in the phase B1 study for the Detection Subsystem (DSS) of the Hipparcos project. This study was done in the framework of the MESH industrial consortium with Matra, Toulouse, France, as a prime contractor. The phase B1 is a definition phase in which most of the trade-offs have to made. For this purpose studies have been performed related with possible hardware solutions, design, subsystem and system level performances, cost, reliability and so on. The phase B1 has three milestones:

- System Definition Review (SDR)
- Subsystem Definition Review (SSDR)
- Proposal for phase B2 and phase C/D.

The work at SRL was focused on the detectors and required electronics and mechanical structures of the DSS. The DSS contains as primary detectors two Image Dissector Tubes (IDT's) and, additionally, four photomultiplier tubes. The actual performance of the IDT's is directly related with the astrometric performance of Hipparcos, and because of this a measuring program has been undertaken at SRL during phase B1 in order to determine the detailed performance characteristics of IDT's. The results of this measuring program have been presented at the SSDR. A photograph of an IDT with focus and deflection coil and magnetic shielding as used for the measurements is given in Figure 18. At the end of 1982 the proposal for the phase B2 has been presented to Matra and agreement has been reached between Matra and SRL on the work to be performed during phase B2 and the conditions of the work. Due to some delay in the Hipparcos program the C/D proposal has not yet been made in 1982 but will be issued by SRL in the first half of 1983.

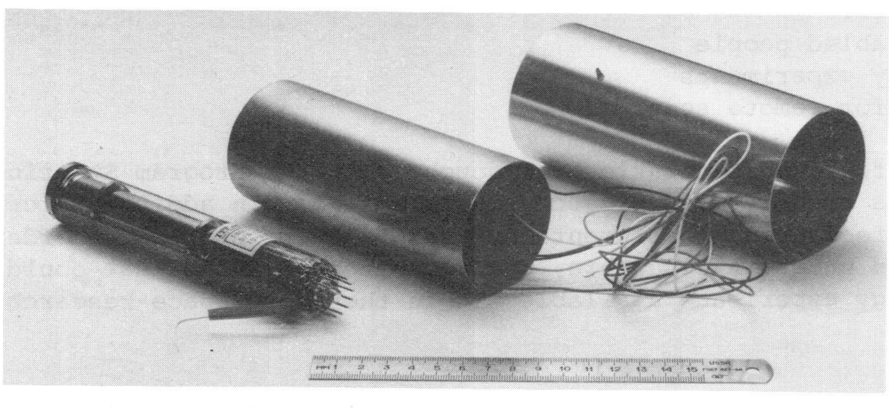


Fig. 18: Image Dissector Tube for HIPPARCOS.

4. ONDERWIJSVERSLAG 1 SEPTEMBER 1981 - 31 AUGUSTUS 1982

1. Commissies

1.1. *Onderwijscommissie van de vakgroep*

Samenstelling per 31 augustus 1982: De Graaff (vz.), Claas (stud.), Fokker, Kuperus, Mulder (stud.), Van Nieuwkoop, Schrijver (LRO), Zwaan, Hubenet (secr.).
Aantal vergaderingen: 4.
Belangrijkste onderwerpen: herprogrammering i.v.m. de invoering van de tweefasen-structuur, i.h.b. de colleges voor het eerste en het tweede programmajaar; de overgangsregeling voor studenten die nog volgens het oude programma studeren, terwijl er mogelijk in bepaalde studieonderdelen geen onderwijs meer wordt gegeven; onderwijsprogramma 1982/83; interacademiaal college; evaluatie van het onderwijseffect van het waarnemingsstation in Ausserbinn.

1.2. *Onderwijscommissie van de Sectie Sterrekunde van de Academische Raad (OCSS of OCSSAR)*

Utrechtse vertegenwoordigers: Fokker (vz. OCSS), Mulder (stud.).
Aantal vergaderingen: 2.
Belangrijkste onderwerpen: afronding van de besprekingen over de eerste fase van de tweefasen-structuur, interacademiale colleges (evaluatie vorige, planning volgende).

1.3. *Andere commissies en functies (zie ook hoofdstuk 6.3)*

De Jager: geaggregeerd hoogleraar Vrije Universiteit te Brussel.
Kuperus: buitengewoon hoogleraar in de sterrekunde bij het Departement Wiskunde van de Universitaire Instelling Antwerpen te Wilrijk (België).

2. 39e Nederlandse Astronomenconferentie

Deze werd door het Sterrenkundig Instituut van de Universiteit van Amsterdam georganiseerd. Geconstateerd kan worden dat de belangstelling van de zijde van de staf aan het verminderen is. Dit kan verband houden met de hoger wordende kosten, welke weer het gevolg zijn van de halvering van de bijdrage van het Leids Kerkhoven-Bosschafonds en het vervallen van die van het Ministerie. Mocht deze tendens blijvend zijn, dan komt het voortbestaan van dit door Prof. Minnaert in 1941 in het leven geroepen evenement in gevaar!

3. Voorkandidaatsonderwijs

3.1. *Aantallen studenten*

Onderstaande tabel - ontleend aan het Nederlands Tijdschrift voor Natuurkunde en aan eigen gegevens - toont de verdeling van de aantallen eerstejaarsstudenten over de Nederlandse universiteiten in de jaren 1977 t/m 1981.

	1977	1978	1979	1980	1981
Universiteit van Amsterdam	8	12	11	10	7
Rijksuniversiteit Groningen	10	8	14	13	8
Rijksuniversiteit Leiden	12	24	27	22	24
Kath. universiteit Nijmegen	5	7	1	0	2
Rijksuniversiteit Utrecht	28+17*	14+12*	21+8*	14+4*	12+9*
	63+17*	65+12*	74+8*	59+4*	53+9*

*A1 + A0 (A0 kent men elders niet; deze studenten zullen elders verdeeld zijn over natuurkunde en wiskunde).

3.2. 1ste-jaarscollege

Algemene college

docent	onderwerp	aantal college-uren	aantal studenten
H. Hubenet	inleiding	16	61
H. Lamers	inwendige bouw en evolutie van sterren	26	43
A. Schadee	steratmosferen	26	39

3.3. 1ste-jaarspracticum

Algemene practicum I(1):
Dit practicum wordt in het tweede semester gegeven.
Medewerkende stafleden: Brants, Van Gent, De Landtsheer en Martens
Studentassistenten: Burm, Van der Post en Verberne
Aantal inschrijvingen: 47
Aantal groepen: 3
Aantal avonden per groep: 15

3.4. 2e-jaarscollege

a. Vervolg algemene college

docent	onderwerp	aantal college-uren	aantal studenten
W. de Graaff	hemelmechanica	16	35
J.M.E. Kuijpers	ijle materie	16	37
J.R.W. Heintze	sterrenstelsels	16	37
T. de Groot	geschiedenis van het heelal	10	32
Kuperus	epiloog	2	onbekend

b. Keuzecolleges

docent	onderwerp	aantal college-uren	aantal studenten
J.R.W. Heintze	dubbelsterren	ca. 30	28
P. Hoyng	plasma-astrofysica	ca. 30	22

3.5. 2e-jaarspractica

a. Vervolg algemene practicum I(2)

Dit practicum wordt in het 1ste semester gegeven.
Medewerkende stafleden: Brants, Van Gent, De Landtsheer en Martens
Aantal inschrijvingen: 29
Aantal groepen: 2
Aantal avonden per groep: 10

b. Voortgezette practicum II

Dit practicum wordt in het 2e semester gehouden.
II-th., theoretisch deel
Leider: De Groot
Aantal aanmeldingen: 10.

II-instr., instrumenteel deel
Leiders: H. Nieuwenhuijzen en C.J.Th. Gunsing
Aantal aanmeldingen: 12.

Practicum II is alleen verplicht voor A1-studenten.

4. Nakandidaatsonderwijs

4.1. *Aantallen kandidaten*

Het verloop van het aantal kandidaten met hoofdvak sterrekunde te Utrecht gedurende de laatste 10 jaar vertoont het volgende beeld:

peildatum	kandidaten bezig of klaar met praktisch werk	kandidaten sterrekunde
1 sept. 1973	14 (3 th.)	22
1 sept. 1974	19 (4 th.)	28
1 sept. 1975	23 (3 th.)	30
1 sept. 1976	25 (5 th.)	33
1 sept. 1977	27 (2 th.)	36
1 sept. 1978	26 (1 th.)	32
1 sept. 1979	28 (4 th.)	29
1 sept. 1980	23 (3 th.)	29
1 sept. 1981	22 (2 th.)	27
1 sept. 1982	23 (3 th.)	29

Het verschil tussen de aantallen in kolom 2 en 3 geeft dus het aantal studenten dat kandidaatsexamen heeft gedaan en te kennen heeft gegeven in sterrekunde te willen doorgaan, maar nog niet met het praktisch werk (dat begint met de zg. oriënteringsronde) is begonnen.

Tussen haakjes de aantallen studenten met de hoofdrichting theoretische sterrekunde; aantallen ook opgenomen in de getallen vóór de haakjes.

4.2. *Nakandidaatscolleges*

4.2.1. *Utrechtse colleges*

docent	onderwerp	aantal studenten
C. de Jager	steropbouw en evolutie (hoofdcollege 1e en 2e sem., 2 j.u.)	16
H.G. van Bueren	neutronensterren en zwarte gaten (keuzecollege 1e sem., 2 sem.u.)	15
C. Zwaan	magnetische activiteit in sterren (keuzecollege 2e sem., 2 sem.u.)	16 (+ 8 afgestudeerden)
J. van Nieuwkoop	radio-astronomische waarneemtechnieken*) (2e sem., 2 sem.u.)	8

*) college in het kader van het bijvak "instrumentatie in de sterrekunde".

4.2.2. *Interacademiaal college*

Het I.A.C. "moderne optische waarneemtechnieken" werd gecoördineerd door Prof.Dr. H.C. van de Hulst (Leiden) en Dr. J. van Paradijs (UvA). Het werd gegeven te Utrecht op zeven woensdagen van 3 februari t/m 12 mei. Docenten waren: H.C. van de Hulst (Leiden), C. van Schooneveld (Leiden), R. Hoekstra (Utrecht), H. van de Stadt (Utrecht), T. Kamperman (Utrecht), J. Tinbergen (Leiden), R.S. le Poole (Leiden). Het aantal deelnemers bedroeg naar schatting 20 à 30, waarvan ca. 5 uit Utrecht. De tentaminering zou in de volgende cursus plaatsvinden.
Studenten met bijvak "instrumentatie in de sterrekunde" mogen dit college hiervoor opvoeren.

4.3. *Colloquia e.d.*

4.3.1. *Dinsdagmiddagcolloquia*

Deze colloquia vonden eerst plaats o.l.v. Hearn en vanaf 19 januari o.l.v. Verbunt. In het tijdvak 8 september 1981 t/m 11 mei 1982 waren 23 bijeenkomsten. 11 colloquia werden verzorgd door Utrechtse sprekers (één hiervan was Prof. van Bueren, die op 15 december 1981 een afscheidscolloquium hield met als titel: Zicht op de horizon?), 7 door medewerkers van andere Nederlandse instituten: Klinkhamer (Leiden), De Graauw (ESTeC), Isaacman (Leiden), V.d. Horn (Amsterdam), De Zeeuw (Leiden), Oort (Leiden), Oerlemans (KNMI).
Van buitenlandse instituten kwamen 5 gastsprekers: Kopal (Manchester University), Pettini (Royal Greenwich Observatory), Bowyer (Berkeley, USA), Machado (CNIE, Buenos Aires), Spruit (Max Planck-Institut, München).

4.3.2. *Extra colloquia*

Extra colloquia werden gehouden door Pinault (Univ. British Columbia, Canada), Beckers (Multi Mirror Telescope, Tucson, USA), Spruit (Max Planck-Institut, München), Kudritzki (Kiel), Makita (Mitaka, Tokyo). Op het LRO spraken bovendien Howard (Mt. Wilson Obs.), Spicer (Zürich), Delache (Nice), Jerzykiewicz (Wrocław).

4.3.3. *Werkcolloquia*

Onder leiding van Kuijpers werden 23 "koffiepraatjes" gehouden (eenmaal door een student) op woensdagmorgen van 10:30-11:00 uur met aansluitende discussie.

N.B. De dinsdagmiddagcolloquia en de koffiepraatjes behoren niet meer tot het verplichte studieprogramma, maar worden hier traditiegetrouw vermeld.

4.3.4. *Studentencolloquia*

Deze stonden onder leiding van Fokker en Hubenet. Negenmaal hield een student een spreekbeurt. De studentencolloquia werden bijgewoond door 7 tot 16 studenten.

4.4. *Inschakeling van de studenten bij het wetenschappelijk onderzoek*

Aan het einde van de verslagperiode waren er vermoedelijk 29 kandidaten met hoofdvak sterrekunde, waarvan 4 met hoofdrichting theoretische sterrekunde. Van die 29 waren er 6 (1 th.) nog niet begonnen en 16 (3 th.) bezig of juist klaar met een klein, groot of theoretisch onderzoek; 7 studenten waren bezig met andere studieonderdelen. De verdeling van de 16 studenten over de verschillende docenten en medewerkers was als volgt:

Sterrewacht:	klein	groot	theor.	totaal
Heintze		2		2
Kuperus			3	3
Kuijpers	1			1
Nieuwenhuijzen		1		1
Van de Stadt		1		1
Zwaan		3		3
LRO				
Den Boggende		1		1
Heise		1		1
Hoyng		1		1
De Jager	1			1
Lamers		1		1
totaal	2	11	3	16

Op het Laboratorium voor Ruimteonderzoek werkten 2 studenten in het kader van hun praktisch werk natuurkunde.

4.5. *Studentenwaarnemingen*

Wederom was Nieuwenhuijzen coördinator voor dit onderdeel. In de loop van het verslagjaar werkten 7 studenten gedurende ca. 1 maand op het waarnemingsstation te Ausserbinn, waar zij helderheidsmetingen verrichtten aan Algolsystemen in het kader van het onderzoek van Heintze. Twee studenten deden met de zonneopstelling metingen aan Ca II-lijnen in het kader van het onderzoek van Zwaan naar magnetische velden op sterren.

4.6 *Diverse onderwijsactiviteiten*

In subfaculteitsverband levert de vakgroep bijdragen tot het natuurkundeonderwijs:
- Van de Stadt gaf de natuurkundecolleges "trillingen, golven en optica" en "optica II".
- De Groot werkte mee aan het werkcollege natuurkunde.
- Vermue assisteerde bij het natuurkundepracticum.
- Van Nieuwkoop en Nieuwenhuijzen waren betrokken bij het werk van de afdeling signaalverwerking; Van Nieuwkoop nam het onderdeel "ontwerpen in de electronica" van een college signaalverwerking voor zijn rekening.

Verder moet vermeld worden:
- Nieuwenhuijzen was betrokken bij het werk van de vakgroep informatica; een student werkt onder zijn supervisie.
- Fokker gaf een college "inleiding tot de astrofysica" (2 sem.u. voor studenten van de afdeling Technische Natuurkunde van de T.H. te Eindhoven; over dit college werden 14 tentamens afgelegd.

5. Tentamens, examens en promoties

5.1. *Tentamens voor het kandidaatsexamen*

Algemene colleges:

docent	onderwerp	mondeling	schriftelijk
H. Hubenet	inleiding		64[1)]
H. Lamers	inwendige bouw en evolutie		53
A. Schadee	steratmosferen	1	46
W. de Graaff	hemelmechanica		35
J. Kuijpers	ijle materie		38
J.R.W. Heintze	sterrenstelsels	1	44
T. de Groot	geschiedenis van het heelal		32

[1)] multiple choice

Keuzecolleges:

J.R.W. Heintze	dubbelsterren	5	
J. Heise	neutronensterren en zwarte gaten	9	
P. Hoyng	plasma-astrofysica		12
J. van Nieuwkoop/ H. van de Stadt	instrumentatie in de sterrekunde	1	

5.2. *Tentamens voor het doctoraalexamen*

Vaak worden deze tentamens in de vorm van een scriptie afgenomen.

Hoofdcolleges:

docent	onderwerp	mondeling	schriftelijk
C. de Jager	inwendige bouw en evolutie	4	
M. Kuperus	plasma-astrofysica	3	

Keuzecolleges:

H. van Bueren	neutronensterren en zwarte gaten	1	9
J. van Nieuwkoop	ontwerpen in de electronica	2*)	
H. van de Stadt	Fourier- en Laplace-transformaties	1	

*) waarvan 1 maal voor het bijvak signaalverwerking

5.3. *Examens*

a. Kandidaatsexamens met sterrekunde als hoofd- of als bijvak:

A1	8
A0	5
N1	15
W3-stk	3
totaal	31

b. Doctoraalexamens met sterrekunde als hoofd- of als bijvak:

hoofdvak, algemene richting	5
hoofdvak, theoretische richting	1
hoofdvak, totaal	6

Eenmaal werd een klein bijvak sterrekunde genomen en wel bij een hoofdvak theoretische natuurkunde.

5.4. *Promoties*

Op 1 september 1981 liepen er ca. 18 promotieonderzoeken en op 31 augustus 1982 ca. 14. In de loop van het verslagjaar vonden er 5 promoties plaats.
Dr. R. Mewe was coreferent bij de promotie van A.F.G. van der Meer op een proefschrift getiteld: The influence of impurities on the discharge behaviour in Spica (promotor Prof. C.M. Braams) - RUU - 26 oktober 1981.

5. POSTDOCTORAAL ONDERWIJS, POPULARISERING

5.1. Postdoctoraal onderwijs

In het voorjaar van 1982 werd een cursus gegeven over het onderwerp "Zonnevlammen". Sprekers en onderwerpen waren:

C. de Jager	:	de fysische toestand en de ontwikkeling van zonnevlammen
M. Kuperus	:	energie-opslag en instabiliteiten
G. Stevens	:	energierijke deeltjes tengevolge van zonsactiviteit

Het boekje met de tekst van de voordrachten zal verschijnen in het voorjaar van 1983.

R. J. Rutten gaf gedurende twee maal 6 avonden een her/bijscholingscursus "Astrofysica" te Breda en Roosendaal voor VWO-leraren.

5.2. Popularisering

Prof.dr. W. de Graaff bleef voorzitter van de Stichting De Koepel. Prof.dr. C. de Jager bleef voorzitter van de Stichting Simon Stevin en werd vice-voorzitter van het Cosmocenter (i.o.). Verschillende medewerkers van het Instituut droegen bij aan de popularisering van de wetenschap door het schrijven van artikelen voor ZENIT en andere tijdschriften.

De volgende personeelsleden gaven populaire voordrachten:

A. Duijveman	1 voordracht
R.H. van Gent	3 voordrachten
W. de Graaff	18 voordrachten
T. de Groot	2 voordracht
R. Hoekstra	1 voordracht
P. Hoyng	2 voordrachten
H. Hubenet	4 voordrachten
K.A. van der Hucht	3 voordrachten
C. de Jager	13 voordrachten
J.S. Kaastra	1 voordracht
T.M. Kamperman	8 voordrachten
M. Kuperus	2 voordrachten
J.M.E. Kuijpers	1 voordracht
H.J.G.L.M. Lamers	3 voordrachten
H. Nieuwenhuijzen	3 voordrachten
R.J. Rutten	6 voordrachten
A. Schadee	2 voordrachten
H. van der Stadt	1 voordracht
C. Zwaan	4 voordrachten

5.3. Rondleidingen

In het verslagjaar verzorgde de Sterrewacht 15 rondleidingen. Het Laboratorium voor Ruimteonderzoek verzorgde 1 rondleiding.

5.4. Tentoonstellingen

Het Laboratorium voor Ruimteonderzoek werkte mee aan 1 tentoonstelling, te zamen met de Werkgroepen Ruimteonderzoek uit Groningen en Leiden.

6. PERSONEEL

6.1. VAKGROEP STERREKUNDE

Wetenschappelijk personeel:

A.A. van Ballegooijen (tot 1-12-82)
J.J. Brants
A.D. Fokker
R.H. van Gent
*W. de Graaff
T. de Groot
R.H. Hammerschlag
A.G. Hearn
J.R.W. Heintze
H. Hubenet
*C. de Jager
J.S. Kaastra
J.M.E. Kuijpers
N.P.M. Kuin (tot 1-10-82)
M. Kuperus
*H.J.G.L.M. Lamers
A.C. de Landtsheer
P.C.H. Martens
F. Middelkoop (tot 1-7-82)
O. Namba
H. Nieuwenhuijzen
J. van Nieuwkoop
B.J. Oranje
R.J. Rutten
*A. Schadee
H. van de Stadt
F. Verbunt (tot 1-7-82)
*J.J. Vermue
C. Zwaan

*) Werkzaam ten dienste van het Laboratorium voor Ruimteonderzoek

Technisch, administratief en huishoudelijk personeel:

H.J. van Amerongen
A.J. van Drie
G.P. van Gelder
G.W. Geijtenbeek
J.L.A. van Hensbergen
P.W. Hoogendoorn
R. van de Klomp
E. Landré
I. Nagtegaal
J.G. Odijk-Nijenhuis
R.G. Paat
D.H. Peters-Kamerbeek
H.J. Repelaar van Driel
J.H. Rosenbaum
P.A.H. Beskers-Smulders
R.A. van Stappershoef
L.C.M. Swart
H.C. van Tessel-van Dalen

N.A. van Veenendaal-Pietersen
G. van Voorst
W.J. Wimmers
E.J. van der Zalm

6.2. LABORATORIUM VOOR RUIMTEONDERZOEK

Wetenschappelijk personeel:

H.F. van Beek
A. Boelee (tot 1-5-82)
A.J.F. den Boggende
A.C. Brinkman
A. Duijveman
J.H. Dijkstra
*W. de Graaff
E.H.B.M. Gronenschild
F.R. de Gruijl
C.J.T. Gunsing
J. Heise
R. Hoekstra
P. Hoyng
K.A. van der Hucht
*C. de Jager
T.M. Kamperman
*H.J.G.L.M. Lamers
R. Mewe
J.J. van Rooijen
*A. Schadee
J. Schrijver
G.A. Stevens
Z. Svestka
*J. Vermue
T. Wijchers

*) Voor rekening van de Vakgroep Sterrekunde

Technisch, administratief en huishoudelijk personeel:

M.J. van den Akker-Henstra
T.E. d'Arnaud
E.J. van den Berg
P. Bleijenberg
P. Blom
J.M. Braun
L. van den Brink
**P. van den Brink
H.B. Buurmans
D.C. van Cooten
L.C. Cramer-van der Kaaden
A. van Dongen
G.J. van Dijen
W.J.M. van Dijk
W.C.A. van Dijkhuizen
M.Y. Galama
W.F.P.A.L. Geerlings
J. van Geffen
J.M.C. van Genechten
H. Goulooze
P.J. de Groene
E.M.P.G. Gronenschild-Overhof
R. van der Haar
J. van Hal

**) Voor rekening van de Universiteit van Utrecht

M.A. Hilhorst
W.A. Hoogenraad
H.J.A. de Hoogt
A.G. van der Horst
J.P. Imhof
W.F.R. Janssen
A.E.T. José-Veldkamp
P. van Kralingen
J.J.M. van der Laan
M.C. Lahr
J.G. Leeman
B.J. van Leeuwen
M. van der Linden
P. Lowes
A.G.W. Maas
C.W.G.M. du Maine
W.A. Mels
Z.N. van der Meij
C.G. Monderen
W.A. Muijsert
H.C.C. Müller
A.P. Naber
M.T.B.L. Negenborn
E. Niekerk
A.J. den Ouden
T.M.J. Peters
A. Rook
F.A. van Rooijen
M.J. Rijnsent
Z.T.R. Salverda
E.W.P. Schrijvers
U.D. Smissaert van de Haere
C. Timmerman
J. Veenendaal
G.J.J. Velders
K. Veldkamp
L.G. Verhage
P. Versteeg
J.B. Vogel
J.C.J. Wagenaar
F.R. Werkhoven
G. van Westen
G.J. Wiersma
W. Zandee

In het laboratorium werkten in het kader van hun klein resp. groot onderzoek of afstudeerwerk de volgende aantallen studenten:

7 met hoofdrichting astrofysica
2 met hoofdrichting natuurkunde
3 HTS studenten natuurkunde.

6.3. LIDMAATSCHAPPEN VAN RADEN, COMMISSIES, BESTUREN, REDACTIES, ENZ.

N.B. In deze lijst is niet opgenomen:
a) lidmaatschappen van raden en commissies van subfaculteit, vakgroep of laboratorium - men zie daarvoor hoofdstuk 2
b) lidmaatschappen van organen van de Nederlandse sterrekunde - men zie hoofdstuk 6.4.
Lidmaatschappen van IAU commissies zijn evenmin vermeld.

H.F. van Beek :
- landelijk coördinator Innovatie Overleg GROC
- lid van ESA EUV-spectrometer team
- lid van NASA Science Working Group voor POF (Pinhole Occulter Facility)

A.C. Brinkman :
- lid van Observing Program Panel van EXOSAT
- lid van 'phase A study team' van ESA voor X-80
- lid COSPAR Sub-Commission E1 (Galactic and Extragalactic Astrophysics)

J.H. Dijkstra :
- secretariaat Landelijk Innovatie Overleg GROC (vanaf 29-3-82)

A.D. Fokker :
- lid van de Universiteitsraad

W. de Graaff :
- voorzitter Algemeen Bestuur Stichting De Koepel
- lid subcommissie ruimtevaarttechniek van de Wetenschappelijke Commissie NLR/NIVR

T. de Groot :
- lid hoofdbestuur Nederlandse Vereniging voor Weer- en Sterrekunde

A.G. Hearn :
- lid Organizing Committee, Commission 36, IAU
- lid Board of Directors, Astronomy and Astrophysics

R. Hoekstra :
- lid van Magellan Science Team van ESA voor begeleiding van industriële fase A studie van Magellan
- Principal Investigator van de High Dispersion Spectrograph voor de 4.2 m telescoop op La Palma in het kader van de Brits-Nederlandse samenwerking

P. Hoyng :
- lid COSPAR Sub-Commission E2 on Solar Physics

H. Hubenet :
- lid Bestuur Stichting Utrechts Universiteitsmuseum
- lid Examencommissie M.O. Natuur- en Scheikunde

K.A. van der Hucht :
- secretaris Ned. Ver. voor Ruimtevaart
- penningmeester Ned. Astronomenclub
- uitv. secr. Steering Committee Indonesian-Netherlands Astrophysics
- lid Organizing Committee Int. Astr. Unie commissie 44 'astronomy from space'
- lid COSPAR Interdisciplinary Scientific Committee E 'Research in Astrophysics from space'

C. de Jager :
- secretaris Commissie Jungfraujoch, KNAW
- lid Bestuur Nederlands Instituut Vliegtuigbouw en Ruimtevaart
- voorzitter Bestuur Stichting Volkssterrewacht 'Simon Stevin'
- vice-voorzitter Stichting Cosmocenter
- lid Koninklijke Nederlandse Akademie van Wetenschappen
- buitenlands lid Koninklijke Vlaamse Academie van Wetenschappen en Schone Kunsten

- buitenlands lid Academie Royale des Sciences, Luik
- lid International Academy Astronautics
- associate Royal Astronomical Society
- lid Space Science Committee of European Science Foundation
- president Joint Organization Solar Observations (JOSO)
- voorzitter Steering Committee SMY en SMA van SCOSTEP
- voorzitter Science Program Committee (European Space Organization)
- editor-in-chief Solar Physics
- editor-in-chief Space Science Reviews
- redactielid Journal Quantitative Spectroscopy and Radiative Transfer
- co-editor Astrophysics and Space Science
- redactielid Astrophysics Space Science Library
- redactielid Memorie della Societa Astronomical Italiana
- redactielid Geophysics Astrophysics Monographs
- redactielid Astronomische Nachrichten
- redactielid Advances in Space Research
- redactielid Advances Earth-oriented Applications of Space Technology

T.M. Kamperman :
- lid 'Calibration Working Group' voor ESA Faint Object Camera
- lid 'Instrument Science Team' voor ESA Faint Object Camera

M. Kuperus :
- voorzitter 'Board Solar Physics Section' van de division of Astronomy and Astrophysics van de EPS
- lid Editorial Board van Solar Physics
- voorzitter benoemingscommissie hoogleraar 'Hoge Energie Astrofysica'
- vice-president commissie 12, IAU

H.J.G.L.M. Lamers :
- lid 'IUE Selection Committee' ESA
- lid 'Editorial Advisory Board' Astrophysical Letters
- consultant 'Vilspa IUE Satellite Station', Madrid

H. Nieuwenhuijzen :
- lid Bestuursorgaan voor Informatie Verwerkende Apparatuur
- vice-voorzitter Forth Interesse Groep

J. van Nieuwkoop :
- voorzitter Werkgroep JIP van CESRA

R.J. Rutten :
- lid Board Solar Physics Division, European Physical Society

H. van de Stadt :
- lid Werkgroep Optische Faciliteiten van het NCA
- plaatsvervangend lid MT Users committee

Z. Svestka :
- voorzitter van COSPAR Sub-Commission E2 (tot mei 1982) (Research in Solar Physics from Space)
- vice-voorzitter SCOSTEP Steering Committee on Solar Interplanetary Phenomena
- voorzitter SCOSTEP Organizing Committee on FBS
- vice-voorzitter SMY en SMA Steering Committee
- editor-in-chief Solar Physics
- lid Editorial Board 'Geophysics and Astrophysics Monographs'
- lid Editorial Board 'Astrophysics and Space Science Library'
- lid Editorial Board 'Space Science Reviews'
- corresponderend lid International Academy of Astronautics

C. Zwaan : - lid Stuurgroep Brits-Nederlandse samenwerking van ASTRON
- voorzitter programmacommissie Nederlandse 'Light Collector' gestationeerd op ESO sterrewacht
- Alternative Board Member Joint Organization for Solar Observations (JOSO)
- voorzitter Working Group III (JOSO) 'Projects and Programs'
- lid Editorial Board 'Solar Physics'
- lid Working Group Survey Program for Stellar Activity
- Science Working Group Solar Optical Telescope (NASA).

6.4. DEELNEMING AAN ORGANEN VAN DE NEDERLANDSE STERREKUNDE

Commissie Landelijke Werkgemeenschap Zon en Sterren, leden

A.G. Hearn
J.R.W. Heintze
P. Hoyng
C. de Jager
J.M.E. Kuijpers
M. Kuperus
H.J.G.L.M. Lamers
R. Mewe
Z. Svestka
C. Zwaan (vz.)

Commissie Landelijke Werkgemeenschap Interstellaire Materie, leden

R. Hoekstra
H.J.G.L.M. Lamers
H. van de Stadt (secr.)

Commissie Landelijke Werkgemeenschap Sterrenstelsels, lid

J.M.E. Kuijpers

Sectie Sterrekunde Academische Raad, leden

T. de Groot
C. de Jager (vz.)
H.J.G.L.M. Lamers
J. van Nieuwkoop (secr.)
C. Zwaan

A.D. Fokker (voorzitter Onderwijscommissie)

Nederlands Comité Astronomie, leden

C. de Jager (vz.)
J. van Nieuwkoop (secr.)

Bestuur Stichting Astronomisch Onderzoek in Nederland, lid

J. van Nieuwkoop

Curatorium Sterrekundig Waarneemstation Ausserbinn, leden

C. de Jager
J. van Nieuwkoop (secr.)

Commissie Sterrekundig Waarneemstation Ausserbinn, leden

A.D. Fokker
J.R.W. Heintze (beheerder)
C. de Jager (vz.)

Stichting Radiostraling Zon en Melkweg

J. van Nieuwkoop (lid AB en DB)
C. Zwaan (lid AB)

A.D. Fokker (lid Zoncommissie)
T. de Groot (lid Zoncommissie)
P. Hoyng (lid Zoncommissie)
M. Kuperus (lid Zoncommissie)
J.M.E. Kuijpers (secr. Zoncommissie)
J. van Nieuwkoop (vz. Zoncommissie)

7. GEBOUWEN EN BEHUIZING; NIEUWE INSTRUMENTEN; COMPUTERGEBRUIK; REIZEN

7.1. Huisvesting

Evenals in het vorige jaarverslag kan vermeld worden dat de Universiteit overweegt om het Instituut onder te brengen "in of nabij de thans bij de natuurkunde in gebruik zijnde gebouwen in het Fysicacomplex in de Uithof". Ook in 1982 werd echter het startsein om te beginnen met een haalbaarheidsonderzoek nog niet door het College van Bestuur gegeven. Weer is het aantal jaren dat "het instituut verdeeld is over vijf deels ongeschikte gebouwen, verspreid over de stad Utrecht" met één vermeerderd. Het onderhoud van de panden in de binnenstad wordt tot het allernoodzakelijkste beperkt hetgeen voor de toekomst van de karakteristieke gebouwen op Zonnenburg het ergste doet vrezen.

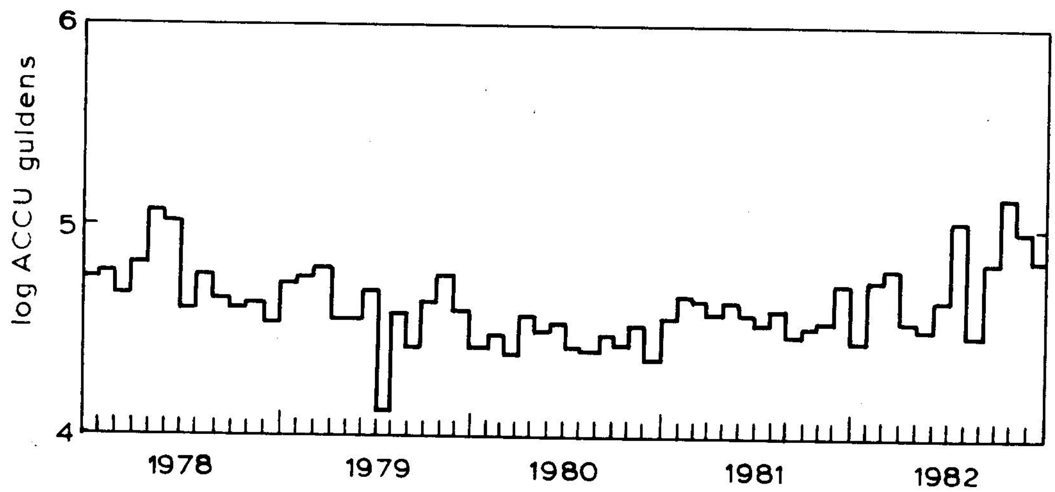
7.2. Aanschaf van nieuwe instrumenten

In 1982 werden bij het Laboratorium voor Ruimteonderzoek de volgende nieuwe instrumenten aangeschaft:

- Programmable digitizer 7020
- Advant Mass Storage Unit type MSB 3121
- Multichannel Analyzer System mod. ND 65
- Variflex RO-printer with spec. character sets
- Floating Point Unit mod. 8704
- 2 MB Memory board. mod. 005-17667
- Vidissector F 4012 RP with stepped faceplate

7.3. Computergebruik

Dit wordt geïllustreerd door de onderstaande afbeelding die het gebruik van de centrale rekenfaciliteit (ACCU) over de laatste 5 jaar weergeeft, uitgedrukt in zg. ACCU-guldens.



Vergeleken met de laatste twee jaren valt er in 1982 een duidelijke stijging van het computergebruik waar te nemen. Hieronder een tabel met het gebruik in ACCU-guldens per jaar sinds 1978:

1978: 731 000 ACCU-guldens
1979: 600 000 ACCU-guldens
1980: 390 000 ACCU-guldens
1981: 490 000 ACCU-guldens
1982: 776 000 ACCU-guldens.

In 1982 werd een begin gemaakt met het ACCU-project: UARTS. Ons instituut fungeert hierbij als testsite. Het UARTS-project beoogt de toegang tot de centrale computer van het ACCU te vereenvoudigen, met name ten aanzien van de commandotaal en het datatransport. Het ligt in de bedoeling dat in de loop van 1983 de resultaten van dit proefproject beschikbaar komen.
In 1982 werd een nieuwe terminalkamer op de begane grond van Servaas Bolwerk 12 betrokken. Alleen de UT200-terminal en de kaartponser staan nu nog in de kelder. Gelijktijdig werd door het ACCU de multiplexer geïnstalleerd en werd het terminalbestand uitgebreid c.q. vernieuwd. De 4 aan de multiplexer verbonden terminals kregen hierdoor een snelheid van 1200 band. Een flinke vooruitgang vergeleken met de oude 300-band lijnen en vooral van belang voor de plottende terminal.
In december 1982 tenslotte werd onze privé discruimte op het ACCU aanzienlijk vergroot. We delen nu op 50/50-basis een disc met de chemie, hetgeen ca. 2000 record blocks meer opleverde. De nu totaal beschikbare discruimte (ca. 4500 RB) blijft overigens nog aan de krappe kant.

7.4. Buitenlandse reizen langer dan 4 dagen

a. Laboratorium voor Ruimteonderzoek

- H.F. van Beek; Boulder U.S.A.; 11-20 januari 1982: Meeting Pinhole/occulter Facility working group.
- H.F. van Beek; Ottawa, Canada; 16-27 mei 1982: COSPAR congres bijwonen.
- H.F. van Beek; Huntsville, Alabama, U.S.A.; 17-24 september 1982: Meeting/Pinhole/occulter Facility working group.
- H.F. van Beek; Washington, U.S.A.; 19-26 oktober 1982: SMM-IWG meeting.
- A.J.F. den Boggende; Washington, U.S.A.; 18-22 oktober 1982: Bezoek Columbia Univ./IEEE conferentie/EXOSAT calibratiemetingen.
- A.C. Brinkman; Ottawa, Canada; 19-28 mei 1982: COSPAR congres.
- A.C. Brinkman; Moskou, U.S.S.R.; 10-15 mei 1982: COMIS project.
- A.C. Brinkman; Moskou, U.S.S.R.; 13-19 september 1982: COMIS project.
- A.C. Brinkman; Moskou, U.S.S.R.; 25 november - 3 december 1982: COMIS project.
- W.C.A. Dijkhuizen; Palestine, U.S.A.; 26 augustus - 9 oktober 1982: BUSS campagne.
- J.H. Dijkstra; München, West-Duitsland; 18 april - 19 mei 1982: Longbeam test EXOSAT.
- A. Duijveman; Ottawa, Canada; 16 mei - 5 juni 1982: STP symposium - SMY symposium.
- A. Duijveman; Moskou, U.S.S.R.; 5 april - 1 mei 1982: Het vergelijken van HXIS waarnemingen.
- A. Duijveman; Tokyo, Japan; 3-24 oktober 1982: US-Japan seminar.
- M.Y. Galama; Washington, U.S.A.; 14-28 februari 1982: HXIS.
- M.Y. Galama; London, Engeland; 12-17 december 1982: Cursus Data-gen. AOS/VS.
- P.J. de Groene; New York, U.S.A.; 12-20 oktober 1982: HIPPARCOS meeting.
- P.J. de Groene; Friedrichshafen, West-Duitsland, Toulouse, Frankrijk; 20-24 december 1982: HIPPARCOS meeting.
- H. Goulooze; New York, U.S.A.; 12-20 november 1982: HIPPARCOS meeting.
- C.J.Th. Gunsing; Wisconsin, U.S.A.; 28 februari - 6 maart 1982: HIPPARCOS meeting.
- C.J.Th. Gunsing; Princeton, U.S.A.; 20-28 oktober 1982: HIPPARCOS meeting.
- J. van Hal; Palestine, U.S.A.; 22 augustus - 9 oktober 1982: BUSS campagne.
- J. Heise; Haifa, Patras, Griekenland; 7-20 augustus 1982: IAU Colloquium no. 72.
- J. Heise; Madrid, Spanje; 7 juli - 16 augustus 1982: Waarnemingen aan Cataclysmische Variabelen.
- J. Heise; Nice, Frankrijk; 6-12 november 1982: European Workshop on Very Hot Astrophysical Plasmas.
- M.A. Hilhorst; Toulouse, Frankrijk; 8-18 augustus 1982: Test ISPM - HUS.
- M.A. Hilhorst; Friedrichshafen, West-Duitsland; 30 november - 3 december 1982: ISPM - HUS integratie.
- R. Hoekstra; Wisconsin, U.S.A.; 28 februari - 4 maart 1982: HIPPARCOS meeting.
- R. Hoekstra; Toulouse, Frankrijk; 13-17 september 1982: HIPPARCOS meeting.
- R. Hoekstra; Princeton, U.S.A.; 20-28 oktober 1982: HIPPARCOS meeting.
- R. Hoekstra; London, U.K.; 22-26 november 1982: HIPPARCOS meeting.

- K.A. van der Hucht; München, West-Duitsland; 18-22 januari 1982: UV en IR waarnemingen Wolf-Rayet sterren.
- K.A. van der Hucht; Villafranca, Spanje; 24-27 april 1982: ESA-IUE waarnemingen WC9 sterren.
- K.A. van der Hucht; Lembang, Indonesië; 5-19 juni 1982: Bezoek Observatorium Bosscha.
- K.A. van der Hucht; Patras, Griekenland; 15-27 augustus 1982: General Assembly IAU.
- K.A. van der Hucht; Palestine, U.S.A.; 18 september - 6 oktober 1982: BUSS campagne.
- C. de Jager; Huntsville, U.S.A.; 21-27 februari 1982: IGW-PI meeting SMM.
- C. de Jager; Patras, Griekenland; 17-27 augustus 1982: 17e General Assembly van de IAU.
- C. de Jager; Japan; 3 oktober - 15 november 1982: diverse instituten.
- T.M. Kamperman; Palestine, U.S.A.; 22 augustus - 13 oktober 1982: BUSS campagne.
- A.C. de Landtsheer; Vilspa, Spanje; 12-17 oktober 1982: IUE waarnemingen.
- M. van der Linden; Palestine, U.S.A.; 26 augustus - 9 oktober 1982: BUSS campagne.
- P. Lowes; Toulouse, Frankrijk; 4-15 augustus 1982: Zonnesimulatietest ISPM project.
- Z.N. van der Meij; Palestine, U.S.A.; 14-18 april 1982: BUSS campagne.
- Z.N. van der Meij; Palestine, U.S.A.; 17 augustus - 9 oktober 1982: BUSS campagne.
- W.A. Mels; Moskou, U.S.S.R.; 10-15 mei 1982: COMIS project.
- R. Mewe; Cambridge, U.S.A.; 13 mei - 5 juni 1982: COSPAR congres no. 24.
- R. Mewe; Zürich, Zwitserland; 1-7 augustus 1982: IAU symposium no. 102, EXOSAT waarnemingen.
- R. Mewe; Nice, Frankrijk; 6-11 november 1982: European Workshop on Very Hot Astrophysical Plasmas.
- A. Naber; Moskou, U.S.S.R.; 10-15 mei 1982: COMIS project.
- M.J. Rijnsent; Parijs, Frankrijk; 31 maart - 8 april 1982: Electronica Tentoonstelling.
- F.A. van Rooijen; Neuried, West-Duitsland; 18 april - 19 mei 1982: Long beam test EXOSAT.
- F.A. van Rooijen; Neuried, West-Duitsland; 15-24 september 1982: Calibratie L.E. 2 model van EXOSAT.
- C.J. Schrijver; Cambridge, U.S.A.; 13 mei - 17 juli 1982: Einstein-waarnemingen interpreteren.
- C.J. Schrijver; Dublin, Ierland; 28 augustus - 1 september 1982: IAU colloquium nr. 73.
- E.W.P. Schrijvers; Palestine, U.S.A.; 17 augustus - 9 oktober 1982: BUSS campagne.
- W. Spronk; Ausserbinn, Zwitserland; 23 september - 16 oktober 1982: Waarnemingen t.b.v. EXOSAT.
- Z. Svestka; Tokio, Japan; 2-15 oktober 1982: Seminar : Recent Advances in the Understanding of Solar Flares and presentation HXIS results.
- Z. Svestka; Ottawa, Canada; 5-30 mei 1982: IWG/SCOSTEP/STP/SMY/COSPAR meeting, symposia.
- F.R. Werkhoven; London, U.K.; 12-17 december 1982: Cursus Data General, AOS/VS.
- T. Wijchers; Palestine, U.S.A.; 22 augustus - 9 oktober 1982: BUSS campagne.
- W. Zandee; Moskou, U.S.S.R.; 10-15 mei 1982: COMIS project.
- W. Zandee; Moskou, U.S.S.R.; 13-19 september 1982: COMIS project.

b. Vakgroep Sterrekunde

- A.A. van Ballegooijen; Zürich, Zwitserland; 1-8 augustus 1982: IAU Symp. 102 "Solar and Stellar Magn. Fields".
- A.G. Hearn; Patras, Griekenland; 8-28 augustus 1982: Gen. Ass. IAU.
- A.G. Hearn; Triëste, Italië; 30 augustus - 8 september 1982: Conference "Non-thermal structures".
- J.R.W. Heintze; Villafranca, Spanje; 12-17 oktober 1982: IUE waarnemingen.
- J.R.W. Heintze; Patras, Griekenland; 17-26 augustus 1982: Gen. Ass. IAU.
- J.M.E. Kuijpers; Catania, Italië; 9-15 augustus 1982: IAU Coll. 71 "Activity in Red Dwarfs".
- J.M.E. Kuijpers; Patras, Griekenland; 17-27 augustus 1982: Gen. Ass. IAU.
- J.M.E. Kuijpers; Nice, Frankrijk; 6-11 november 1982: "Workshop Very Hot Astrophysical Plasmas".

- M. Kuperus; Ottawa, Canada; 16-21 mei 1982: Symp. "Solar Terrestrial Physics".
- M. Kuperus; Göteborg, Zweden; 8-15 juni 1982: Conf. on Plasmaphysics.
- M. Kuperus; Zürich, Zwitserland; 1-8 augustus 1982: IAU Symp. 102 "Solar and Stellar Magn. Fields".
- M. Kuperus; Florence, Italië; 13-29 september 1982: Werkbezoek Oss-Astr. Arcetri.
- P.C.H. Martens; Patras, Griekenland; 8-29 augustus 1982: Gen. Ass. IAU.
- P.C.H. Martens; Zürich, Zwitserland; 1-8 augustus 1982: IAU Symp. 102 "Solar and Stellar Magn. Fields".
- H. Nieuwenhuijzen; Jungfraujoch, Zwitserland; 10-24 december 1982: Waarnemingsreis.
- R.J. Rutten; Patras, Griekenland; 17-28 augustus 1982: Gen. Ass. IAU.
- F. Verbunt; Leicester, U.K.; 23-27 maart 1982: Congres "Cataclysmic Variables".
- C. Zwaan; Zürich, Zwitserland; 1-8 augustus 1982: IAU Symp. 102 "Solar and Stellar Magn. Fields".

c. *Reizen naar het waarnemingsstation te Ausserbinn*

- R.G. Verberne; 27 januari - 26 februari.
- J.H.G. Rosenbaum; 4 maart - 4 april.
- A.T.P. Langerwerf; 1 augustus - 31 augustus.
- R.H. van Gent; 15 augustus - 15 september.
- J.H. Muller; 3 december - 8 januari 1983.
- J.J. Claas; 1 november - 3 december.
- S. Slijkhuis; 13 november - 18 december.
- R.E. Molenaar; 18 december - 18 januari 1983.

8. SCIENTIFIC DISCOURSES IN 1982

- A.A. van Ballegooijen: 'Structuur van de overgangslaag tussen convectieve en radiatieve zones in een sterinwendige'; Utrecht; 1982.
- A.O. Benz (also for B.R. Dennis, J.W. Leibacher, R. Mewe, A. Poland, J. Schrijver, G. Simnett, J.B. Smith Jr., K.T. Strong, J. Sylwester): 'Evidence for simultaneous presence of large and small loops in solar flares'; IAU, Patras; August.
- A.C. Brinkman (on behalf of X-80 study team): 'X-80, A European X-Ray Astrophysics Mission'; Nice, France; November 10.
- A. Duijveman: 'New discoveries with the HXIS instrument'; Moscow, USSR; 14 April.
- A. Duijveman (also for P. Hoyng, K.A. Marsh and H. Zirin): 'Hard X-ray and microwave imaging of two flares during the impulsive phase'; Ottawa, Canada; 19 May.
- A. Duijveman (also for P. Hoyng): 'Imaging of impulsive solar flare phenomena'; Tokyo, Japan; 7 October.
- R.H. van Gent: 'Algolsystemen waargenomen in het Utrechtse Fotometrische Systeem (UPS)'; Amsterdam; 26 November.
- R.A. Harrison (also for G.M. Simnett, P. Hoyng, H. Lafleur and H.F. van Beek): 'Hard X-ray studies on the large coronal feature on June 29, 1980'; Maynooth, Ireland; 4-6 August.
- A.G. Hearn: 'New ideas about hot stars demanded by space observations'; Patras, Greece; 19 August.
- A.G. Hearn: 'Critique of hot star observations'; Grado, Italy; 31 August.
- A.G. Hearn: 'The Polar Wind Theory'; Grado, Italy; 3 September.
- K.A. van der Hucht: 'The Most Massive Stars'; Observatorium Bosscha, Lembang, Indonesia; 4-19 June.
- K.A. van der Hucht: 'Ultraviolet catalogues and atlasses'; Patras, Greece; 25 August.
- C. de Jager: 'HXIS results'; Huntsville, USA; 24 February.
- C. de Jager: 'Flare triggering and the impulsive phase'; Huntsville, USA; 26 February.
- C. de Jager: 'Ontstaan en ontwikkeling van zonnevlammen'; Akademie, Brussels; 3 March.
- C. de Jager: 'Shock-driven mass loss in stars'; Oxford, UK; 27 April.
- C. de Jager: 'Review of galactic Ultra-violet Astronomy'; Madrid, Spain; 11 May.
- C. de Jager: 'International solar space missions'; COSPAR, Ottawa, Canada; 25 May.
- C. de Jager: 'Summary of the DISCO-workshop'; Bunnik, the Netherlands; 23 June.
- C. de Jager: 'The physics of solar flares'; Bern, Switzerland; 25 June.
- C. de Jager: 'The relevance of space for development'; Vienna, Austria; 4 August.
- C. de Jager: 'The solar maximum year'; IAU, Patras, Greece; 19 August.
- C. de Jager: 'Mass loss in astrophysics'; IAU, Patras, Greece; 24 August.
- C. de Jager: 'Origin and development of solar flares'; IAU, Patras, Greece; 24 August.
- C. de Jager: 'Development of flare morphology in X-rays'; Tokyo, Japan; 5 October.
- C. de Jager: 'Mass loss from supergiants'; Kyoto, Japan; 20 October.
- C. de Jager: 'Solar physics, past and future'; Toyokawa, Japan; 28 October.
- C. de Jager: 'Mass loss from supergiants'; Nagoya, Japan; 29 October.
- C. de Jager: 'History and development of space research'; Kanezawa, Japan; 2 November.
- C. de Jager: 'Solar flares'; Hida Observatory, Japan; 3 November.
- C. de Jager: 'Origin and development of solar flares'; University Tokyo, Japan; 9 November.
- C. de Jager: 'The European space program'; ISAS, Tokyo, Japan; 11 November.
- C. de Jager: 'Mass loss from supergiants'; Mitaka Obs., Tokyo, Japan; 12 November.
- C. de Jager: 'Structure and development of solar flares'; LAPAN, Bandung, Indonesia, 17 November.
- C. de Jager: 'Zonnevlammen'; Vrije Universiteit Amsterdam; 17 December.
- M. Kuperus: 'Magnetosferen van neutronensterren'; Eindhoven, the Netherlands; 22 April.
- M. Kuperus: 'Electrodynamics of the outer Solar Atmosphere'; Ottawa, Canada; 18 May.
- M. Kuperus: 'Recent Developments on Coronal Heating'; Noordwijk, the Netherlands; 28 May.

- M. Kuperus: 'Electrodynamic coupling of the heliosphere to the (sub)photosphere'; DISCO workshop, Bunnik, the Netherlands; 23 June.
- M. Kuperus: 'Magnetosferen van neutronensterren'; Jutphaas, the Netherlands; 2 November.
- J.M.E. Kuijpers: 'VLBI aan zonnevlammen'; Amsterdam; 10 March.
- J.M.E. Kuijpers: 'Runaway versnelling in zonnevlammen'; Amsterdam; 1 February.
- J.M.E. Kuijpers: 'Very Long Baseline Interferometry of Solar Flares'; Catania; 12 August (poster).
- J.M.E. Kuijpers: 'Very Long Baseline Interferometry of solar flares'; Nice; 8-10 November (poster).
- H.J.G.L.M. Lamers: 'Physical processes in the atmospheres of early-type stars'; Abingdon, England; 26 April.
- H.J.G.L.M. Lamers: 'Summary of the Workshop on Mass Loss from Astronomical Objects'; Abingdon, England; 28 April.
- H.J.G.L.M. Lamers: 'Mass loss from hot stars'; Armagh, North Ireland; 6 May.
- H.J.G.L.M. Lamers: 'The effects of mass loss on stellar evolution'; Armagh, North Ireland; 20 May.
- H.J.G.L.M. Lamers: 'Stellar Winds and Interstellar Bubbles'; Cargese, Corsica; 10 September.
- H.J.G.L.M. Lamers: 'Supernovae and Supernova Remnants'; Cargese, Corsica; 13 September.
- H.J.G.L.M. Lamers: 'Interstellar Bubbles'; Universiteit van Amsterdam; 7 October.
- H.J.G.L.M. Lamers: 'Materie uitstoting door hete zware sterren: over de fysische oorzaken en de gevolgen voor de levensloop van sterren'; Utrecht, the Netherlands; 11 November.
- H.J.G.L.M. Lamers: 'Stellar winds and interstellar bubbles'; Villafranca, Spain; 17 November.
- H.J.G.L.M. Lamers: 'Supernovae and their Remnants'; Villafranca, Spain; 19 November.
- H.J.G.L.M. Lamers: 'The physical state of the Interstellar Medium'; Villafranca, Spain; 23 November.
- A.C. de Landtsheer: 'Interpretatie van lichtkrommen'; Utrecht, the Netherlands; 23 February.
- P.C.H. Martens (also for M. Kuperus): 'A thermal catastrophe in a resonantly heated coronal loop'; Zürich, Switzerland; 25 August.
- P.C.H. Martens: 'The thermodynamics of coronal loops'; TH-Twente, the Netherlands; 26 May.
- P.C.H. Martens: 'De thermische structuur van coronale lussen'; Papendal, the Netherlands; 6 May.
- P.C.H. Martens: 'De thermische evolutie van coronale lussen'; Amsterdam, the Netherlands; 10 December.
- P.C.H. Martens: 'Methoden in de niet-lineaire dynamica en hun toepassingen in de sterrenkunde'; Utrecht, the Netherlands; 14 December.
- R. Mewe: 'Einstein X-ray observations of solar-type stars'; Lyngby; 23 February.
- R. Mewe (also for C.J. Schrijver, C. Zwaan): 'Coronal Activity in F-, G- and K-type Stars: Relations between Parameters Characterizing Stellar Structure and X-ray Emission'; COSPAR, Ottawa; 27 May.
- R. Mewe (also for C.J. Schrijver, E.H.B.M. Gronenschild, C. Zwaan): 'Coronal Activity in F-, G- and K-type Stars: Empirical Relations between Stellar Parameters'; Zürich; 3 August.
- R. Mewe: 'Coronale activiteiten van F, G en K sterren'; Amsterdam, the Netherlands; 17 September.
- R. Mewe: 'Physics of hot, optically thin, and thermal astrophysical plasmas'; Nice; 8 November.
- H. Nieuwenhuijzen: 'The FORTH programming environment'; Rochester, USA; 17 May.
- H. Nieuwenhuijzen: 'The FORTH programming environment'; Denver, USA; 26 May.
- J. van Nieuwkoop: 'Instrumentatie voor de Radioastronomie van de Zon'; TH Twente, the Netherlands; 29 March.
- B.J. Oranje: 'Emissie van koele sterren als indicatoren van magnetische structuur'; Groningen, the Netherlands; 22 October.

- R.J. Rutten: 'NLTE in Fe I'; Papendal, the Netherlands; 10 May.
- R.J. Rutten: 'Validity of LTE-RE models as line predictors'; Patras, Greece; 23 August.
- R.J. Rutten: 'LTE masking and the Kiev Fe I oscillator strengths'; Patras, Greece; 24 August.
- J. Schrijver (also for R. Mewe, J. Sylwester, K.T. Strong, R.D. Bentley): 'Transient ionization conditions in solar flares. Analysis of high-resolution spectra'; Dublin, Ireland; 1 September.
- G.M. Simnett (also for E.J. Schmahl, R.A. Harrison, P. Hoyng, H.F. van Beek): 'Evidence for extensive magnetic structures between AR 2522 and 2530 from studies of flares on June 24, 1980'; Maynooth, Ireland; 4-6 August.
- G.A. Stevens: 'Energetic particles in interplanetary space'; Amsterdam, the Netherlands; 23 February.
- G.A. Stevens: 'Zonnevlammen'; Utrecht, the Netherlands; 24 March.
- J.J. van Rooijen: 'ISEE-3 energetic particle results'; Bunnik, the Netherlands; 23 June.
- Z. Svestka (also for C. de Jager): 'The Solar Maximum Year'; Ottawa, Canada; 14 May.
- Z. Svestka: 'SCOSTEP Activities in the Netherlands'; Ottawa, Canada; 15 May.
- Z. Svestka: 'Post-Flare Coronal Arches'; Ottawa, Canada; 20 May.
- Z. Svestka: 'Gaps in Solar-Terrestrial Physics (the Sun)'; Ottawa, Canada; 22 May.
- Z. Svestka (also for A. Schadee): 'Pre- and Post-Flare X-ray Variations in Active Regions'; Tokyo, Japan; 7 October.
- C. Zwaan: 'Chromospheric and coronal indication of stellar magnetic structure'; Zürich, Switzerland; August.
- C. Zwaan: 'Observational requirements; groundbased'; Zürich, Switzerland; August.

9. PUBLICATIONS 1982

a. Doctoral dissertations

- C. Slottje: 'Atlas of fine structures of dynamic spectra of type IV-dm and some type II radio bursts'; 5 April (H.G. van Bueren; A.D. Fokker).
- F. Middelkoop: 'Ca II H and K emission from late-type stars'; 5 July (C. Zwaan).
- F. Verbunt: 'Mass transfer in stellar X-ray sources'; 7 July (H.G. van Bueren and E.P.J. van den Heuvel).
- N.P.M. Kuin: 'Stellar coronae and their mass loss'; 29 September (A.G. Hearn).
- A.A. van Ballegooijen: 'Sunspots and the physics of magnetic flux tubes in the Sun'; 29 November (C. Zwaan, H.C. Spruit).
- J. Heise: 'Some observational aspects of compact galactic X-ray sources'; 15 December (C. de Jager).

b. Scientific publications

- A.A. van Ballegooijen: 1981 - A Model for Slender Flux Tubes and its Application to Sunspots - in L.E. Cram and J.H. Thomas (eds.) 'The Physics of Sunspots', Sacramento Peak Observatory, p. 115.
- A.A. van Ballegooijen: 1981 - Energy Transport in Deep Umbral Layers - in L.E. Cram and J.H. Thomas (eds.) 'The Physics of Sunspots', Sacramento Peak Observatory, p. 140.
- A.A. van Ballegooijen: 1982a - The Structure of the Solar Magnetic Field below the Photosphere, I: Adiabatic Flux Tube Models - Astron. Astrophys. *106*, 43.
- A.A. van Ballegooijen: 1982b - The Overshoot Layer at the Base of the Solar Convective Zone and the Problem of Magnetic Flux Storage - Astron. Astrophys. *113*, 99.
- F. Beeckmans, C.A. Grady, F. Macchetto, K.A. van der Hucht: 1982 - Spectral variations of Theta Muscae (WC6+O9.5I) in the ultraviolet - in C.W.H. de Loore & A.J. Willis (eds.) 'Wolf-Rayet Stars', IAU Symp. *99*, 311.
- J.J. Brants, L.E. Cram and C. Zwaan: 1981 - An Emerging Flux Region: Some Preliminary Results - in L.E. Cram and J. Thomas (eds.) 'The Physics of Sunspots', p. 80.
- J.J. Brants and C. Zwaan: 1982 - The Structure of Sunspots IV: Magnetic Field Strengths in Small Sunspots and Pores - Solar Phys. *80*, 251.
- G.E. Bromage, W.M. Burton, K.A. van der Hucht, F. Macchetto, C-C. Wu: 1982 - Does the WC6 star HD76536 have a compact companion? - in Proc. Third European IUE Conference, ESA SP-176, p. 269.
- F.C. Bruhweiler, T.H. Morgan, K.A. van der Hucht: 1982 - Ultraviolet Emission in the MgII h and k lines in Be stars - Astrophys. J. *262*, 675.
- M. Burger, C. de Jager, G.H.J. van den Oord: 1982 - The pulsation of the outer layers of the Beta Cephei star σ Sco - Astron. Astrophys. *109*, 289.
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